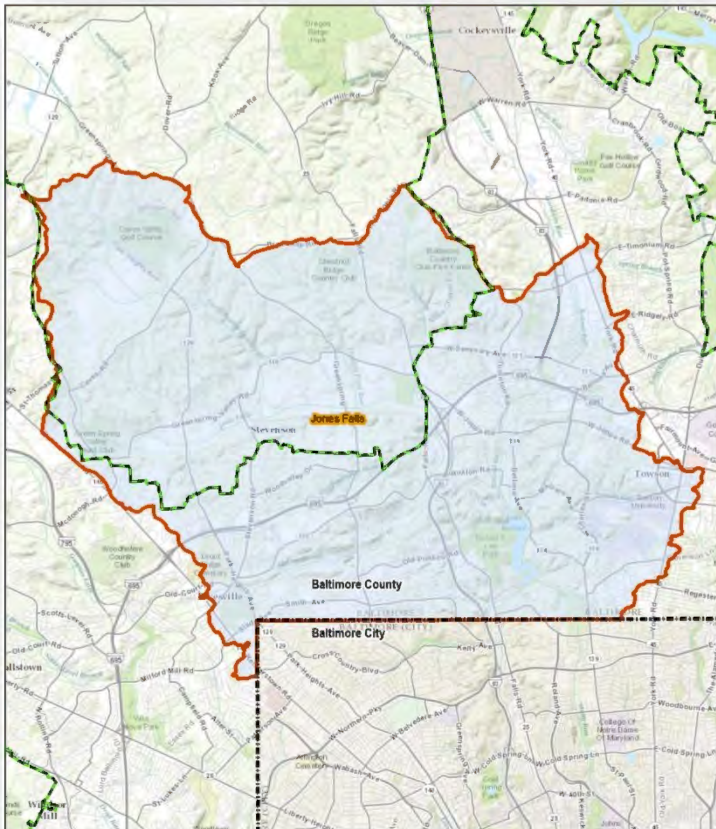
BALTIMORE COUNTY
TMDL IMPLEMENTATION PLAN

Polychlorinated Biphenyls in Jones Falls



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List of Abbreviations

ARA	**Antibiotic Resistance Analysis**
BMP	**Best Management Practice**
BOD	**Biological Oxygen Demand**
BSID	**Biological Stressor Identification**
BST	**Bacteria Source Tracking**
CBP	**Chesapeake Bay Program**
CFR	**Code of Federal Regulations**
Chl a	**Chlorophyll a**
COMAR	**Code of Maryland Regulations**
CWA	**Clean Water Act**
DO	**Dissolved Oxygen**
DPW	**Department of Public Works**
ED	**Extended Detention**
EOF	**Edge of Field**
EOS	**Edge of Stream**
EPA	**U.S. Environmental Protection Agency**
EPS	**Environmental Protection & Sustainability**
FSA	**Farm Service Administration**
HSG	**Hydrologic Soil Groups**
HUC	**Hydrologic Unit Code**
IP	**Implementation Plan**
LA	**Load Allocation**
lbs/yr	**Pounds per Year**
MAST	**Maryland Assessment Scenario Tool**
MD	**Maryland**
MDA	**Maryland Department of Agriculture**
MDE	**Maryland Department of Environment**
MDP	**Maryland Department of Planning**
µg/l	**Micrograms per Liter**
mg/l	**Milligrams per Liter**
MGD	**Million Gallons per Day**
MGS	**Maryland Geological Survey**
MOS	**Margin of Safety**

MPN	**Most Probable Number**
MPR	**Maximum Practicable Reduction**
MS4	**Municipal Separate Storm Sewer System**
NLCD	**National Land Cover Dataset**
NMP	**Nutrient Management Plan**
NOAA	**National Oceanic and Atmospheric Administration**
NPDES	**National Pollutant Discharge Elimination System**
NPS	**Nonpoint Source**
NSA	**Neighborhood Source Assessment**
OIT	**Office of Information Technology**
PAA	**Pervious Area Assessment**
PAI	**Office of Permits Approvals & Inspections**
POM	**Particulate Organic Matter**
PS	**Point Source**
RTG	**Reservoir Technical Group**
SCWQP	**Soil Conservation and Water Quality Plan**
SSA	**Science Services Administration**
SSO	**Sanitary Sewer Overflow**
SWAP	**Small Watershed Action Plan**
SWM	**Stormwater Management**
TMDL	**Total Maximum Daily Load**
TN	**Total Nitrogen**
TP	**Total Phosphorus**
TSI	**Trophic State Index**
TSS	**Total Suspended Solids**
URDL	**Urban Rural Demarcation Line**
USGS	**United States Geological Survey**
USLE	**Urban Soil Loss Equation**
WAG	**Watershed Advisory Group**
WIP	**Watershed Implementation Plan**
WLA	**Waste Load Allocation**
WQBEL	**Water Quality Based Effluent Limitations**
WQIA	**Water Quality Improvement Act**

WQLS	**Water Quality Limited Segment**
WQMP	**Water Quality Management Plan**
WRAS	**Watershed Restoration Action Strategy**
WWTP	**Waste Water Treatment Plant**

This Implementation Plan (IP) has been prepared to address the PCB impairment of fish tissue in Lake Roland, an impoundment within the Jones Falls. PCBs have been found to be negatively affecting the aquatic community. The concentration of PCB in fish tissue that needs to be reduced has been determined by a Total Maximum Daily Load (TMDL) developed by Maryland Department of the Environment and, after a public comment period, submitted to US Environmental Protection Agency (EPA) – Region 3 for review and approval on September 30, 2014. Final TMDL documents can be found at MDE's website under Current Status of TMDL Development in Maryland. See the document entitled: Total Maximum Daily Load of Polychlorinated Biphenyls in Lake Roland of Jones Falls Watershed in Baltimore County and Baltimore City, Maryland.

1.1 What is a TMDL

A TMDL has two different meanings. It is the document that is produced by MDE when any Maryland water body is listed on the state's 303(d) list of impaired and threatened waters. MDE must then submit the TMDL to EPA for approval. Any time a TMDL document is developed, extensive scientific study is done on the pollutant of concern in the listed water body. This study is done with the goal of finding the maximum load of the pollutant that the water body can receive and still meet Maryland's water quality standards. It is often thought of as a "pollution diet" for the watershed. All of the studying and monitoring that is done in preparing the TMDL document boils down to a single maximum load number that will be the target for pollution reduction in the water body. This number is also called a TMDL. In other words, the goal of the TMDL document is to justify the TMDL number, which can be found within the TMDL document.

The TMDL number is expressed as a sum of all the different sources of the pollutant plus a margin of safety (MOS). The MOS value helps to account for any lack of knowledge or understanding concerning the relationship between loads and water quality and also for any rounding errors in the TMDL calculation (calculation format shown below). Expressing the TMDL in terms of this simple equation makes it easier to see where pollution reduction efforts need to be focused. In other words, which sources can be reduced to reach the final TMDL number, by how much they need to be reduced, and which pollution sources are not practical for reduction. The sources that make up the final TMDL number are categorized as either Load Allocation (LA) or Waste Load Allocation (WLA). LAs are all non-point source loads, meaning that they do not come from a single source or pipe. LAs include agricultural runoff, forest runoff, and upstream loads. WLAs are all point source loads, meaning that they do come from a single traceable source. WLAs are further categorized as process water or stormwater. Process water WLA comes from sources that have permits allowing them to release a specific amount of a pollutant into the water. They include individual industrial facilities, individual municipal facilities, and mineral mining facilities. Stormwater WLA is any stormwater that is regulated by a municipal separate storm sewer systems (MS4) permit, water from industrial facilities permitted to release stormwater, and all runoff from construction sites.

All Baltimore County urban stormwater is regulated under Baltimore County's MS4 permit. That means that stormwater WLA includes all of the water that runs to any storm drain within the watershed area. The MOS is the final part of the equation. The MOS can be implicit, meaning that the final TMDL was calculated in such a way that it accounted for any errors without needing to tack an explicit MOS to the end of the sum of load sources equation. When an explicit MOS is necessary, it is assumed that a 5% reduction of the final TMDL number will be sufficient.

TMDL Sum of Load Sources Equation:

$$\textbf{TMDL} = \textbf{LA} + \textbf{WLA Stormwater} + \textbf{WLA Process Water} + \textbf{MOS}$$

1.1.1 How is the Final TMDL Determined

The process of determining the TMDL number can be very complex. Pollution data are regularly collected throughout Maryland by many different federal, state, and local government agencies as well as universities and watershed organizations. The agency or organization may send individuals out to the stream to collect and measure information about the watershed as part of a study or regular monitoring program. Data are also collected from the many different monitoring stations that are located throughout Maryland's watersheds. Some of these monitoring stations have been collecting water data for decades. The U.S. Geological Survey and the Maryland Department of Natural Resources monitoring stations are often used as the data source for Maryland TMDLs. To find out who is keeping an eye on your watershed see MDE's Water Quality Monitoring Web Page.

Complex scientific models are often used to help find a practical number for the total reduction. Models often use existing monitoring data and observations about the watershed area in a calculation that determines the TMDL number. The type of model used and the complexity of the model varies by pollutant, water body type, and complexity of flow conditions. The specific model used for this TMDL is explained in section 3.3.

In all cases, scientists first find a baseline load for the pollutant. The baseline load is how much of the pollutant is in the water body at the time of the study, before restoration actions specifically developed to reach the TMDL number are implemented. The calculated target number, that is the TMDL, is the final goal. It could be thought of as the finish line in the TMDL process. That is not to say that other restoration efforts will not continue once that target is reached, but that the water body will be able to meet state water quality standards and can be removed from the list of impaired and threatened waters for that particular pollutant .

When calculating the TMDL number, a percent reduction and load reduction are usually calculated as well. The load reduction is the difference between the baseline load and the TMDL target. Think of it as the amount that needs to be removed from the system in order to reach the target. The percent reduction is the percentage of the baseline load that needs to be removed in order to reach the TMDL target.

1.2 Geographic Area

Pollution reduction goals are determined by watershed. A watershed is all the land area where all of the water that runs off that land and all the water running under that land drain into the same place. Everything within a watershed is linked by a common water destination. Watersheds exist at many levels: some very large, and some quite small. Identifying your watershed is similar to identifying your current location on a map. You could say you are in the United States, or that you are in Maryland, or that you are in your kitchen at your specific street address. Similarly, you could say that you are in the Mid-Atlantic Region Watershed, which drains to the Atlantic

Ocean, Long Island Sound and Riviere Richelieu, a tributary of the St. Lawrence River. You could also say that you are in the Upper Chesapeake Bay Watershed, which includes the area of drainage to the Chesapeake Bay that is north of the Maryland-Virginia line. Both would describe a watershed that you are located in. However, watersheds can become much more specific.

A system was established by the U.S. Geologic Survey for dividing the U.S. into successively smaller hydrologic units. Each hydrologic unit is identified by a hydrologic unit code (HUC), which range from two to twelve digits. The smaller the scale of the watershed, the more digits it has in its code. For example, the Mid-Atlantic Region is a 2-digit watershed and the Upper Chesapeake Bay is a 4-digit watershed. The 6-digit unit, also known as the "basins" unit, is to serve as the common scale for watershed assessments at the national level, but the condition of these basins can be determined based on an aggregation of assessments of even smaller watershed units. Maryland has chosen to go the route of assessing smaller watershed units. As a result, TMDLs are determined at the 8-digit watershed scale. For a further explanation of HUCs or to see maps of watersheds at different HUC levels, go to: USGS Hydrologic Unit Maps. If you would like to know which Maryland 8-digit watershed you are located in, go to MDE's Find My Watershed Map.

It is important to note that 8-digit watersheds can overlap multiple counties and may, therefore, have several regulating authorities.

1.2.1 Lake Roland: Jones Falls Geographic Area

Lake Roland is located in Baltimore County just north of the city line, within the Jones Falls 8-digit (02-13-09-04) watershed. The Lake Roland watershed covers a total land area of 34,122 acres. It contains the upstream portions of the mainstem of the Jones Falls, the Roland Run and Towson Run tributaries, and direct drainage to the impoundment. This TMDL Implementation plan will specifically address the land area of the watershed and watershed tributaries that are located in Baltimore County (Figure 1.1).

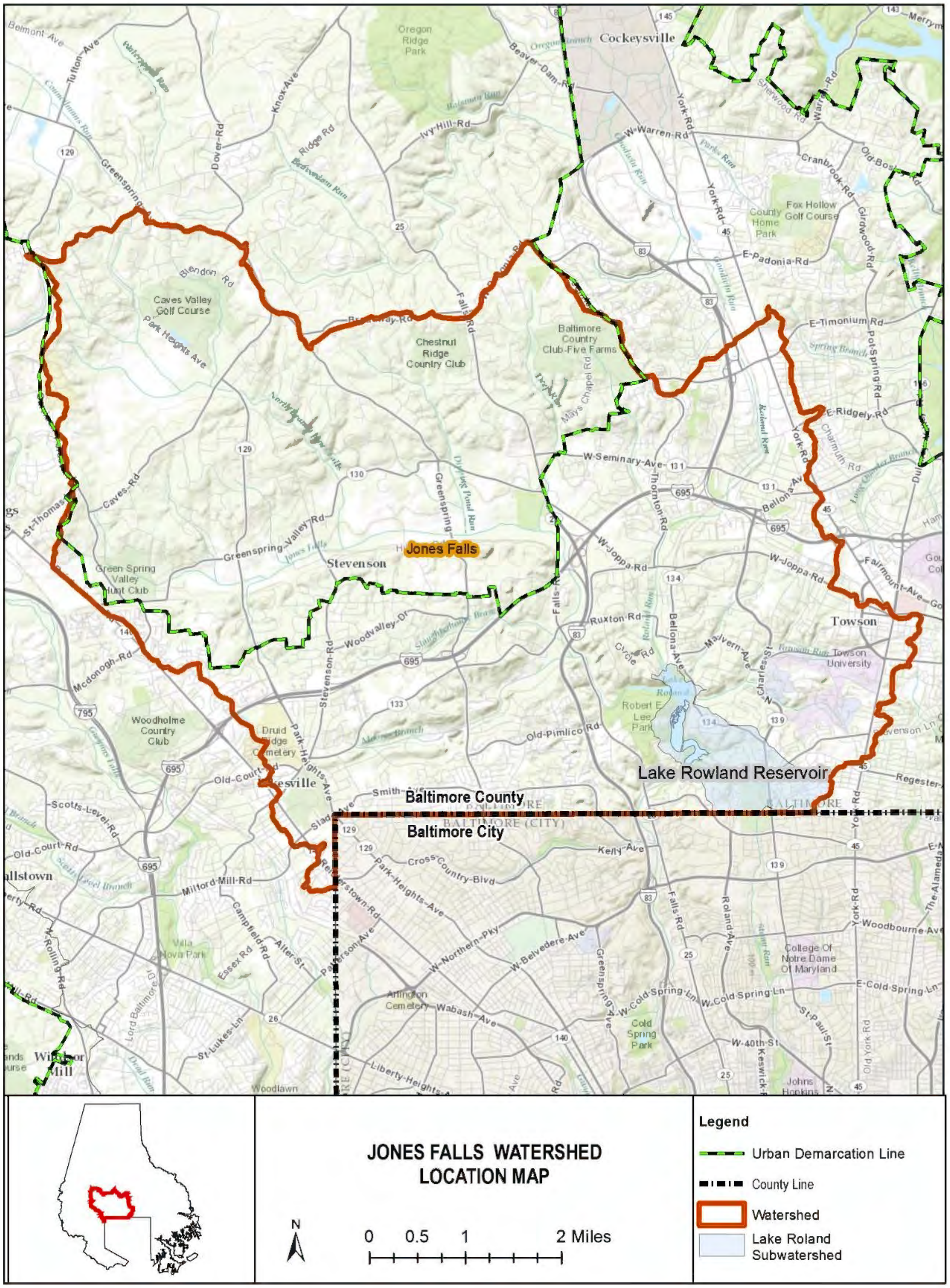

Figure 1.1: Jones Falls Watershed, Baltimore County Portion, including Lake Roland

1.2 Goal of the TMDL Implementation Actions

TMDL Implementation Plan Objective:

Through a cooperative effort of Baltimore County Department of Environmental Protection and Sustainability, other county agencies, local watershed associations, and the general public, to provide a comprehensive plan of action for achieving TMDL targets and ultimately restoring the health of Baltimore County waters to acceptable water quality standards.

Water quality standard for Fish Tissue PCB concentration in the Lake Roland Impoundment: 39ng/g

To return the Fish Tissue PCB levels in the watershed to a level that supports human health consumption by reaching the end point by targeting sediment PCB concentration in Lake Roland.

This will ultimately be measured by determining PCB concentrations in fish tissue, water column, and sediments. Measurements of water quality for the Patapsco LNB will be further discussed in section 3.

1.3 Document Organization

The Baltimore County TMDL implementation plans provide the following information to explain the necessity of the TMDL Implementation Plan and to develop a management strategy that will be followed in order to meet county TMDL reduction targets. The County will take an adaptive management approach that will include periodic assessments to determine progress and identify changes needed in the management strategy to meet the reduction targets in a timely, cost effective manner.

Section 1 - Introduction

This Introduction states the pollutant that is being addressed by the TMDL IP, and the watershed for which the IP was developed. It provides a background on what a TMDL is and how the TMDL is determined. A general description of the geographic area for the specific IP is provided. The Introduction also states the overall goal of the TMDL IP and summarizes the actions that have been identified to bring Baltimore County to that goal. It also includes a brief summary of the contents of the thirteen sections of the TMDL Implementation Plan.

Section 2 - Regulatory Policy and Planning

This part of the document describes the administration and legal authority that mandates the development of Baltimore County's TMDL implementation plan and oversees its fulfillment. It will provide a background of how various regulating authorities and policies are related to the requirement to develop a TMDL Implementation Plan. It will also summarize the various planning guidance documents that have been produced to assist in the development of TMDL Implementation Plans and how TMDL Implementation Plans fit in the overall Baltimore County planning context.

Section 3 - TMDL Summary

The section summarizes the original TMDL document that was submitted by MDE and approved by the EPA. The summary includes: when the TMDL was developed, what is impaired, why the

TMDL was developed, a description of the analysis process that was used to determine the total maximum daily load targets, the baseline year of data collection and analysis, the results from that analysis, and a further break down of the target loads by source sector.

Section 4 - Literature Summary

Each TMDL IP will address a specific pollutant. This part of the document provides an overview of the pollutant that is summarized from published literature. The literature summary includes known sources of the pollutant, the impacts associated with the pollutant, the pathways and transformations of the pollutant, and other relevant ecological processes that affect how the pollutant can be controlled and regulated.

Section 5 - Watershed Characterization

Characterization of the watershed will include geographical and technical information for the portion of the watershed that is specific to each TMDL IP. Each characterization will describe the watershed acreage, population size, geology and soils, topography, land use, streams, infrastructure related to watershed pollution sources, implemented restoration projects since the baseline year, and changes in pollutant load since the baseline year.

Section 6 - Existing Data Summary

This section will include a summary of Baltimore County's existing monitoring data that will be pertinent to the pollutant in question. It may also include some data received from sources other than Baltimore County, such as data from the Maryland Department of the Environment, or other relevant sources.

Section 7 - Summary of Existing Restoration Plans

Previous planning efforts will be summarized in this section. Water Quality Management Plans (WQMP) and Small Watershed Action Plans (SWAP) applicable to the IP area are identified. The process and goals for SWAP development are explained.

Section 8 - Best Management Practice Efficiencies

This section is an explanation of the best management practices that will be used for removing the particular pollutant and the known efficiency of those best management practices. A table will be found in this section of BMPs and the known reduction efficiency for the pollutants that can be reduced by each BMP. BMP efficiencies will also include a discussion of the uncertainty and research needs for BMPs.

Section 9 - Implementation

The implementation section will provide a description of programmatic, management, and restoration actions; and pollutant load reduction calculations to meet the pollutant reduction target for the specific pollutant. For each of the programmatic, management, and restoration actions there will be a list of responsible parties, actions, timeframe of actions, and performance standards.

Section 10 - Assessment of Implementation Progress

Assessment of implementation progress will give Baltimore County a formal method of reporting on the development of implementation and of describing the progressive success of implementation actions. The section will include a description of tracking and reporting mechanisms, and a monitoring plan that includes progress monitoring as well as BMP effectiveness monitoring.

Section 11 - Continuing Public Outreach Plan

This part of the document will be a continuing public outreach plan. It will encourage public involvement in the implementation process, extending beyond the finalization of this document.

Section 12 - References

A list of references used in the creation of this document will be provided.

Section 2 – Legal Authority, Policy, and Planning Framework

The Legal Authority, Policy, and Planning Framework section will present, in brief, the background on the legal requirements that pertain to the development of Total Maximum Daily Loads (TMDLs), and the preparation of TMDL Implementation Plans. This section will also cover the planning framework for the development of the TMDL Implementation Plans (IP). Furthermore, this section is intended to provide the context for the development of this TMDL Implementation Plan and understanding of the linkage between water quality and the TMDL. Whether at the federal or state level there are a number of processes at work that result in the regulations that must be followed to remain within the law. First, legislation is passed by an elected governing body (e.g. Congress, state legislature), and once passed and signed by the executive branch, they become Acts (laws), such as the Clean Water Act. In order to provide guidelines in maintaining compliance with these laws, it is often necessary that regulations be issued to specify the law's requirements. A regulation is a rule issued by a government agency that provides details on how legislation will be implemented, and may set specific minimum requirements for the public to meet if they are to be considered in compliance with the law. These regulations may come in various forms, such as the Code of Federal Regulations (CFR), or Code of Maryland Regulations (COMAR). The information that follows is generally taken from CFR and COMAR.

Under the Code of Federal Regulations (CFR), Title 40 encompasses the regulations enforced by the U.S. Environmental Protection Agency (EPA). These regulations include not only those related to water quality, but also air quality, noise, and a variety of land based regulations (oil operations, etc.)

2.1 Regulatory and Policy Framework

The ultimate regulatory authority for protecting and restoring water quality rests with the federal government through legislative passage of the Clean Water Act in 1972 and subsequent amendments. Prior to the Clean Water Act (1972), the Federal Water Pollution Control Act (1948) served as the basis for controlling water pollution. The Clean Water Act significantly amended the Federal Water Pollution Control Act and established the basic structure for regulating discharges of pollutants into the waters of the United States. Major amendments were enacted in 1977 and 1987 that further strengthened and expanded the Clean Water Act of 1972. The 1987 amendments incorporated the requirement that stormwater discharges from urban (municipal) areas be required to obtain a permit for discharge and that stormwater discharges from industrial sources also be permitted. There have been a number of minor amendments and reauthorizations over the years that have resulted in the law as it now stands.

There are several significant provisions of the Clean Water Act that pertain to TMDLs. These provisions include the requirement that states adopt Water Quality Standards by designating water body uses and set criteria that protect those uses. The Clean Water Act also requires states to assess their waters and provide a list (known as the 303(d) list) of waters that are impaired. The list specifies the impairing substance and requires that a TMDL be developed to address the impairment.

Through policy (memos dated November 22, 2002 and November 12, 2010) the US EPA has indicated that the pollutant loads attributable to regulated stormwater discharges are to be included in the Waste Load Allocation as a point source discharge and not as part of the non-point load. The initial memo also affirmed that the Water Quality-Based Effluent Limitations (WQBELs) in Municipal Separate Storm Sewer System (MS4) permits may be expressed in the form of Best Management Practices (BMPs) and not as numeric limits for stormwater discharges. The second memo clarified that when the MS4 permits are expressed in the form of BMPs, the permit should contain objectives and measurable elements (e.g., schedule for BMP installation or level of BMP performance). By providing both an expected level of BMP performance and a schedule of implementation of the various practices, Baltimore County will have addressed this requirement. This plan once approved by Maryland Department of the Environment (MDE) will be enforceable under the terms of the permit.

2.2 Maryland Use Designations and Water Quality Standards

In conformance with the Clean Water Act, the State of Maryland has developed use designations for all of the waters in the state of Maryland, along with water quality standards to maintain the use designations.

Designated uses define an intended human and aquatic life goal for a water body. It takes into account what is considered the attainable use for the water body, for protection of aquatic communities and wildlife, use as a public water supply, and human uses, such as recreation, agriculture, industry, and navigation. Water quality standards include both the Use Designation and Water Quality Criteria (numeric standards). Water Quality Criteria are developed to protect the uses of a water body.

2.2.1 Use Class Designations

Every stream, lake, reservoir, and tidal water body in Maryland has been assigned a Use Designation. The Use Designation is linked to specific water quality standards that will enable the Designated Use of the water body to be met. A listing of the Use Designations follows:

- Use I: Water contact recreation, and protection of nontidal warmwater aquatic life.
- Use II: Support of estuarine and marine aquatic life and shellfish harvesting (not all subcategories apply to each tidal water segment)
    - Shellfish harvesting subcategory
    - Seasonal migratory fish spawning and nursery subcategory (Chesapeake Bay only)
    - Seasonal shallow-water submerged aquatic vegetation subcategory (Chesapeake Bay only)
    - Open-water fish and shellfish subcategory (Chesapeake Bay only)
    - Seasonal deep-water fish and shellfish subcategory (Chesapeake Bay only)
    - Seasonal deep-channel refuge use (Chesapeake Bay only)
- Use III: Nontidal cold water – usually considered natural trout waters
- Use IV: Recreational trout waters – waters are stocked with trout

The letter "P" may follow any of the Use Designations, if the surface waters are used for public water supply. There may be a mix of Use Classes within a single 8-digit watershed; for example, Gwynns Falls has Use I, Use III, and Use IV Designations depending on the subwatershed.

Table 2-1: Designated Uses and Applicable Use Classes

Designated Uses	Use Classes							
	I	I-P	II	II-P	III	III-P	IV	IV-P
Growth and Propagation of fish (not trout), other aquatic life and wildlife	✓	✓	✓	✓	✓	✓	✓	✓
Water Contact Sports	✓	✓	✓	✓	✓	✓	✓	✓
Leisure activities involving direct contact with surface water	✓	✓	✓	✓	✓	✓	✓	✓
Fishing	✓	✓	✓	✓	✓	✓	✓	✓
Agricultural Water Supply	✓	✓	✓	✓	✓	✓	✓	✓
Industrial Water Supply	✓	✓	✓	✓	✓	✓	✓	✓
Propagation and Harvesting of Shellfish			✓	✓				
Seasonal Migratory Fish Spawning and Nursery Use			✓	✓				
Seasonal Shallow-Water Submerged Aquatic Vegetation Use			✓	✓				
Seasonal Deep-Water Fish and Shellfish Use			✓	✓				
Seasonal Deep-Channel Refuge Use			✓	✓				
Growth and Propagation of Trout					✓	✓		
Capable of Supporting Adult Trout for a Put and Take Fishery							✓	✓
Public Water Supply		✓		✓		✓		✓

2.2.2 Water Quality Criteria

Water quality criteria are developed to protect the uses designated for each water body. Certain standards apply over all uses, while some standards are specific to a particular use. The criteria are based on scientific data that indicate threats to aquatic life or human health. For the protection of aquatic communities the criteria have been developed for fresh water, estuarine water, and salt water. The criteria have been further based on acute levels (have an immediate negative effect) and chronic levels (have longer term effects). The human health criteria are based on drinking water levels, organism consumption levels, or a combination of drinking water and organism consumption levels, or recreational contact bacteria levels.

Dissolved oxygen criteria for all Use Designations is 5 mg/L, except for Use II Designations and special criteria for drinking water reservoir hypolimnion waters (bottom waters of the reservoir).

Bacteria criteria are based on human health concerns, and apply to all Uses, with additional bacteria criteria applicable in shellfish waters. Since none of the local TMDLs are related to the shellfish criteria, they are not discussed here. The human health criteria are based on either the geometric mean of 5 samples or single sample criteria based on the frequency of full body contact, these criteria are displayed in Table 2.2. For the freshwater bacteria TMDLs the indicator bacteria *E. coli* has been used in the development of the TMDL, therefore serves as the water quality end point. The human health recreational contact bacteria criteria are displayed in Table 2-2. The table displays both the geometric mean for bacteria and single sample maximum allow bacteria concentrations based on the frequency of full body contact.

Table 2.2: Bacteria Criteria for Human Health (MPN/100 ml)

Indicator	Steady State Geometric Mean Density	Single Sample Maximum Allowable Density			
		Frequent Full Body Contact Recreation	Moderately Frequent Full Body Contact Recreation	Occasional Full Body Contact Recreation	Infrequent Full Body Contact Recreation

Freshwater (Either Apply)					
Enterococci	33	61	78	107	151
E. coli	126	235	298	410	576
Marine					
Enterococci	35	104	158	275	500

2.3 Planning Guidance

In March of 2008 the EPA released a guidance document on the development of watershed plans entitled *Handbook for Developing Watershed Plans to Restore and Protect Our Waters*. The handbook laid out nine minimum elements to be included in watershed plans, commonly called the "a through i" criteria. The criteria include:

a. An identification of the causes and sources or groups of sources that will need to be controlled to achieve the load reductions estimated in the watershed plan.

b. Estimates of pollutant load reductions expected through implementation of proposed Non-point Source (NPS) management measures.

c. A description of the NPS management measures that will need to be implemented.

d. An estimate of the amounts of technical and financial assistance needed to implement the plan.

e. An information/education component that will be used to enhance public understanding and encourage participation.

f. A schedule for implementing the NPS management measures.

g. A description of interim, measurable milestones for the NPS management measures.

h. A set of criteria to determine load reductions and track substantial progress towards attaining water quality standards.

i. A monitoring component to evaluate effectiveness of the implementation efforts over time.

EPA now evaluates watershed plans on the basis of the above criteria in consideration of its grant funding. The State of Maryland is also increasingly using the above criteria for funding consideration. Baltimore County has used these criteria since the publication of the handbook in the development of its Small Watershed Action Plans; and will use the criteria in the development of this TMDL Implementation Plan.

Maryland Department of the Environment (MDE) developed a guidance document in conjunction with local government representatives entitled *Maryland's 2006 TMDL Implementation Guidance for Local Governments*, which provides a framework for the development of TMDL Implementation Plans. MDE has also provided guidance on the development of TMDL Implementation Plans related to specific pollutants. Guidance for specific pollutants includes:

- PCBs
- Bacteria
- Mercury
- Trash

These guidance documents have been taken into consideration in the development of the Baltimore County TMDL Implementation Plans.

2.4 Water Quality Standards Related to This Implementation Plan

Lake Roland has a Use I designation (see Table 2.1 above for applicable criteria). The PCB TMDL is predicated on the fish tissue concentrations of PCBs associated with Fish Advisories.

The United States Food and Drug Administration (USFDA) established a guidance level for fish tissue of 0.3 mg/kg, as indicated in the TMDL document. Maryland now uses a more conservative listing standard of 39 nanograms/gram of fish tissue. The targeted water quality end point will be fish tissue concentrations of PCBs of <39 nanograms/gram.

COMAR 26.08.02.03-2.G(4) establishes the Maryland water quality criteria for PCBs concentrations in water for the protection of aquatic life and human health. These are detailed in Table 2.3.

Table 2.3: PCBs Water Quality Standards

Substance	Aquatic Life (µg/L)				Human Health		
	Fresh Water		Salt Water		Drinking Water + Organism (µg/L)	Organism Only (µg/L)	Drinking Water MCL (mg/L)
	Acute	Chronic	Acute	Chronic			
Polychlorinated Biphenyls (PCBs)		.014		.03	.00064	.00064	.0005

Since Jones Falls does not supply drinking water, only the aquatic life and fish consumption (organism only) apply. The TMDL analysis indicated that the water quality concentration of PCBs was significantly lower than the most conservative water quality criteria. Therefore, the water column concentrations are not of concern and the only water quality that applies is the fish tissue concentration.

The TMDL summary provides context for the TMDL implementation plan. It is necessary to understand some basic information from the original TMDL document that preceded this particular implementation plan. The TMDL document describes the condition of the watershed at the time that the baseline load of the pollutant was calculated. The baseline load is simply a measurement of the amount of the pollutant that was in the waterbody during a specific time. The baseline load provides a starting pollutant measurement for the county to reduce from, in order to meet the TMDL target. The term TMDL is also used to describe the specific numeric load target, which is explained in detail within the TMDL document. The original TMDL document provides a detailed justification for choosing the TMDL target number. This justification is a description of the entire technical process including monitoring methods and calculations. The following section is a simplification of that section of the TMDL document and a brief explanation of why the TMDL was developed for the specific pollutant in this watershed.

3.1 TMDL Background

- **The Problem:** The TMDL was developed because the level of PCBs in fish tissue, in fish collected from Lake Roland, did not meet the water quality standard for the designated Use I (MDE, 2013), which includes the protection of human health from the consumption of fish in Lake Roland.

The Lake Roland Impoundment of the Jones Falls watershed was listed as being impaired by PCBs in 2002. MDE developed the TMDL and submitted it to EPA in 2013. As of the development of this implementation plan, the TMDL has yet to receive approval by the EPA.

In 2010 MDE conducted surveys to measure levels of tPCBs in the water column and sediments in the Lake Roland Impoundment. Water column PCB samples exceed the human health consumption criterion of 0.64ng/L, but no samples exceeded the criterion for fresh water aquatic life, 14ng/L.

The human health consumption criterion is based on a cancer risk level of 10^{-5} over a lifetime risk of 70 years, consuming 17.5 g of fish per day. A cancer risk level is an estimate of additional instances of cancer that may be expected in the exposed population. This particular risk level means that, at 0.64ng/L PCBs, there is a probability of one additional case of cancer for every 100,000 people exposed.

Fish tissue monitoring can also be used to identify high levels of PCBs in a water body. These measurements can then be used to issue fish consumption advisories and recommendations. Data is measured in skinless fillets, the portion typically consumed by humans. Maryland's current tPCB fish tissue limit is 39ng/g, based on a fish consumption limit of four meals per month. When fish tissue exceeds this limit, the water body is considered to be impaired by PCBs in fish tissue and must be assigned a category 5 listing in the Maryland Integrated Report. Maryland Department of the Environment collected fish tissue samples from Lake Roland impoundment and its watershed in 2000, 2003, and 2007. The tPCB concentrations exceeded the allowable limit for over 50% of the samples taken.

The TMDL endpoint concentration was identified in terms of water column and sediment PCB concentration. Also, due to Clean Water Act requirements, the TMDL must be protective of all designated uses for the water body. The TMDL is specifically protective of the "fishing" designated use; however, meeting the fishing designated use will necessarily meet all other designated uses. This is because the TMDL will be lower than both 1) EPA's human health criterion tPCB water column concentration relative to fish consumption, and 2) Maryland's freshwater chronic criterion tPCB water column concentration. Finally, the "water contact recreation" use will not be a human health risk because dermal contact and consumption of water from recreation activities are not significant pathways for PCB uptake.

For the purposes of this IP, 2010 will be used as the baseline year of data collection because PCBs in sediment and the water column of Lake Roland were measured by MDE in 2010.

3.2 TMDL Development

The first problem that had to be solved was how to develop a TMDL that reduces fish tissue PCB concentrations, but also meets water quality criteria. The water quality model only addresses tPCB concentrations in the water column and sediments, therefore, the final TMDL target must be expressed in these terms. Accordingly, the tPCB threshold for fish tissue was translated into a tPCB water column concentration. An Adjusted Total Bioaccumulation Factor (Adj –tBaf) was used to make this conversion.

The Adj-tBaf evaluates the food web in Lake Roland and predicts the accumulation of PCBs in fish tissue per fish species from the concentrations in the water column and sediment. The factor for the fish species that would require the most environmentally conservative water column tPCB concentrations was used to calculate the TMDL endpoint. The final tPCB water column concentration was compared with the water quality standard for tPCB water column concentration to ensure that the TMDL would meet both the fish tissue criteria and the water quality standards. The water quality standard for tPCB water column concentration of 0.64ng/L proved to be more stringent than the derived value and, thus, was used as the TMDL endpoint for the Lake Roland impoundment.

A similar process was used to determine the TMDL endpoint for sediment in Lake Roland. This analysis utilized an Adjusted Sediment Bioaccumulation Factor (Adj-SediBAF). Based on this analysis a tPCB sediment concentration of 38.1ng/g was used as the sediment TMDL endpoint.

For the purposes of this TMDL, base line conditions were characterized by the mean (average) observed tPCB water column and sediment concentrations in the Lake Roland impoundment, in 2010. The mean was 60.5g/year.

A model was created that took into account the freshwater inputs into the impoundment, sediment and water column exchanges of PCBs, and the natural burial rate of PCBs. Using the baseline conditions as a starting concentration, this model showed that, under current conditions, the impoundment will never meet the TMDL water column endpoint.

By applying a PCB load reduction scenario to this model, it was discovered that a 29% load reduction allowed the Lake Rolland impoundment to meet the TMDL endpoint. Any additional reduction in the load decreased the length of time required to achieve the TMDL endpoint. Sediment concentrations also met the TMDL sediment endpoint for all reduction scenarios from 29% to 100%. The 29% load reduction scenario will take approximately 6,817 days to reach the tPCB water column target and will reduce sediment tPCB concentration to approximately10.5ng/L when the target water column concentrations are achieved.

3.3 TMDL Results

The TMDL can be calculated as the product of the baseline load and one minus the required reduction.

$$TMDL = L_b (1-R) \quad \text{(Equation 3.1)}$$

- L_b: Baseline load
- R: Reduction required from baseline to meet water quality standards

In this TMDL the required reduction was determined to be 29% or .29 and the baseline load was 60.5g/year.

The final TMDL= 43.0g/year

Table 3.1: TMDL and Load Reduction

Baseline Load (g/year)	Target Load Reduction (g/year)	TMDL (g/year)	Percent Reduction (%)
60.5	17.5	43.0	29

3.4 TMDL Reductions Targets by Source Sector

All TMDLs must be presented as a sum of Waste Load Allocations for point sources (WLA) and Load Allocations for non-point sources (LA) and a margin of safety (MOS).

- LA: The LAs of concern for this analysis are atmosphere deposition and unregulated watershed run-off. Contaminated sites were also considered for reduction under this category, but they constitute such a small percentage of the base line load that they are not subject to reductions in this TMDL. Loads from bottom sediments were deemed not directly controllable within the TMDL framework. Therefore, these sources were not assigned any reduction.

- WLA: WLAs in this analysis include NPDES regulated stormwater from Baltimore County and Baltimore City. Waste water treatment plants were considered for reduction, but their contribution to the base line load was so small that any reduction was considered to have no appreciable environmental benefit.

- MOS: MDE included an explicit 5% margin of safety. This percentage is added directly into the final TMDL

The TMDL also includes maximum daily loads (MDL). The MDL is the maximum load on a daily time scale that is consistent with the TMDL. MDLs were calculated for each source category. Their sum represents the final MDL.

Table 3.2: TMDL and MDL Summary for the Lake Roland Impoundment of Jones Falls by Source Category

Source		**Baseline Load (g/year)**	**Percent of Total Baseline Load (%)**	**TMDL (g/year)**	**Load Reduction (%)**	**MDL (g/day)**
Non point Sour ces/L	**Direct Atmospheric Deposition**	**6.4**	**10.58**	**2.5**	**60.94**	**0.02**

	Non-regulated Watershed Runoff		28.9	47.77	20.5	29.07	0.15
	Contaminated Sites		0.2	0.33	0.2	0.00	0.00
	Total LAs		*35.5*	*58.7*	*23.2*	*34.6*	*0.17*
Point Sources/WLAs	WWTP		0.014	0.02	0.014	0.00	0.00
	NPDES Regulated Stormwater	Baltimore County	24.9	41.16	17.6	29.32	0.13
		Baltimore City	0.098	0.16	0.069	29.59	0.0005
	Total WLAs		*25.0*	*41.3*	*17.7*	*29.2*	*0.13*
MOS (5%)					*2.1*		*0.02*
Total			60.5	100	43.0	29	0.32

This review pertains to direct and indirect effects of Polychlorinated biphenyls (PCBs) on fresh water lakes, rivers and streams, specifically those effects that are relevant to the Jones Falls Watershed. This is not intended to be an exhaustive review of primary literature, but rather a summary of the sources, pathways and biological effects of PCBs in non-tidal watersheds from literature available to Baltimore County Department of Environmental Protection and Sustainability.

PCBs are man-made compounds that were manufactured and used in the following from 1929 to 1978:

- electrical equipment,
- flexible PVC coating,
- fluorescent lighting ballasts,
- plastics, flame retardants,
- sealants such as caulk,
- wood flooring finishes,
- carbonless copy paper,
- paints,
- printing ink,
- pesticides,
- hydraulic fuel,
- and lubricants (Bierman, et al., 2009; Mikszewski 2004).

The manufacturing of PCBs is almost completely banned in the United States today. PCBs began to be phased out in the 1970s. Rising concerns about the toxicity and persistent nature of PCBs in the environment led to a federal ban on the sale and production of PCBs in 1979. It is still legal to use PCBs in applications where they will be totally enclosed; this mainly includes large scale transformers and capacitors. The legal ban also allows for up to 50ppm of PCBs in products today as a result of the production process. Because of this legality, many products produced today that are made with yellow pigment and dyes contain the chemical PCB 11 (Grossman, 2013). Unfortunately, PCBs are being released into the environment by leaks, spills, and accidental burning of PCB-containing equipment. Hazardous waste sites that contain PCBs can leak and introduce them into the environment. Illegal or improper dumping of PCB containing materials, such as dumping materials into landfills that are not meant to handle hazardous waste, can contribute to PCB pollution (Environmental Protection Agency, 2013). In addition, one third of all PCBs produced in the U.S. currently reside in the natural environment (Mikszewski, 2004) .For more information on PCB use and history see A BMP Tool Box for Reducing PCBs and Mercury in Municipal Stormwater: section 2.

PCBs released to land and water totaled over 74,000lbs between 1987 and 1993, 99% of which was released to land areas. The majority of these releases occurred in 1990 from PCB use in non-ferrous wire drawing and insulating industries (Environmental Protection Agency, 2013). There are several pathways by which the PCBs released to land areas are eventually transported into waterways. In fact, most of the PCBs released into the environment are bound to aquatic sediments (Mikszewski, 2004).

Major pathways that carry these PCB sources to the waterbody include urban runoff, and erosion of PCB containing sediment (Davis, Hetzel, Oram, & Mckee, 2007). PCBs are water repelling organic chemicals, so their transportation is dependent on sorption to organic carbon and sediments (Bierman, et al., 2009). When PCB contaminants leak or spill, rain water can easily wash the PCB laden sediments into nearby streams or into storm drains, which are unfiltered and connect directly to local water bodies. The PCB bound sediments then settle on the bottom of the water body or remain suspended in the water column. Disturbance of the PCB containing sediment, can re-introduce the PCBs into the water column and ultimately into the food web (Davis, Hetzel, Oram, & Mckee, 2007). PCB-contaminated sediments are often buried by the natural deposition of clean sediments, thus reducing human exposure to the chemical (Davis, Hetzel, Oram, & Mckee, 2007) (Mikszewski, 2004). However, elevated flow rates and erosion can expose the contaminated sediment. Bottom feeding organism, feed off of fine organic material or algae on the floor of the waterbody and so they are naturally consuming these exposed PCB containing sediment particles. (Davis, Hetzel, Oram, & Mckee, 2007) (Mikszewski, 2004). Waste water effluent and atmospheric deposition are other pathways that are only minor contributors (Davis, Hetzel, Oram, & Mckee, 2007). For more information on PCB pathways see A BMP Tool Box for Reducing PCBs and Mercury in Municipal Stormwater: section 3.

PCBs have a tendency to bioaccumulate, which means that they increase in concentration as they ascend the food chain (Mikszewski, 2004). For example, small macroinvertebrates can consume the PCBs as they dig in sediment for food, those macroinvertebrates are eaten by small fish, which are then eaten by medium and large fish. Each organism collects some of the chemical in their bodies at a rate faster than the body can remove it. Eventually, humans consume the medium to large fish that have been building up this chemical in their bodies from consecutive PCB contaminated meals. Bioaccumulating chemicals can build up and stay in human bodies too, especially when humans eat large quantities of fish. Some people may develop serious health problems, such as cancer and neurological problems in children. Others may never exhibit any health problems. It is impossible to know who will be affected by consuming PCB contaminated fish (MDCH). For more on bioaccumulation, see Michigan Department of Community Health's *What is Bioaccumulation?*

PCBs are considered a probable human carcinogen (Bierman, et al., 2009). A carcinogen is a substance and/or exposure that can lead to cancer. Risk of cancers, like non-Hodgkin's lymphoma for example, have been specifically linked to the substance (Mikszewski, 2004). PCBs have also been linked to developmental effects such as learning disorders and low birth weights (Bierman, et al., 2009). In children, they can cause severe neurological problems such as impaired motor and cognitive functions (Mikszewski, 2004). PCBs have 209 distinct structural arrangements, called congeners, each with their own unique chemical properties (Mikszewski, 2004). Lipophilic PCBs can be transferred from a mother to her infant through breast feeding (Mikszewski, 2004). Laboratory animals exposed to PCBs developed liver damage, skin irritation, reproductive dysfunction, and cancer among other health problems (Mikszewski, 2004). For an in-depth review of research from an international group of experts on the health effects of PCBs, see World Health Organization Concise International Chemical Assessment Document 55.

PCBs can have a different level of chlorination, meaning that they differ in the number of chlorine atoms attached their two benzene rings. Each of these distinct PCB chemical compounds, which differ in the number of chlorine atoms and the position of the chlorine on the benzene rings, is a separate PCB congener. Although natural processes remove PCBs from the environment overtime, highly chlorinated PCBs tend to be more persistent in the environment because they are more resistant to biodegradation. This is because the more highly chlorinated congeners bind more tightly to sediments, and microorganisms that are capable of degrading PCBs cannot get to those strongly bound PCB molecules (Mikszewski, 2004). (Environmental Protection Agency, 2013). Once released from sediments, PCBs will volatize relatively rapidly in water, meaning they will become vaporized and released in to the atmosphere (Environmental Protection Agency, 2013). In the vapor phase, the PCBs most often transform by reacting with hydroxyl radicals in the atmosphere. When this reaction occurs, the resulting chemicals have estimated half-lives ranging from 12.9 days to 1.31 years, meaning the amount of the substance in the atmosphere will be naturally reduce by half in that amount of time (Environmental Protection Agency, 2013).

It is possible, through natural processes, to reduce the number of chlorine atoms on the PCB chemical compound, making the PCBs more likely to detach from aquatic sediments (Mikszewski, 2004) (Environmental Protection Agency, 2013). Certain anaerobic organisms are able to dechlorinate PCBs and have demonstrated this in natural environments (Mikszewski, 2004). There are several pathways by which this process can occur, but scientists have not yet defined all of these pathways (Mikszewski, 2004).

PCBs are traditionally controlled by specialized sediment incineration and by land filling (Mikszewski, 2004). Both methods require dredging of river sediments and can result in other potentially negative environmental effects. Other PCB removal methods may be less damaging, but many are still experimental as it is extremely challenging to remediate large areas of PCB contaminated, aquatic sediment.

Section five is intended to characterize Lake Roland Watershed. This section describes the watershed features that influence the conditions of Lake Roland. Included in this section are the natural and human factors that may affect PCB pollution. Portions of this section are derived from the Lower and Northeastern Jones Falls SWAPs.

5.1 The Natural Landscape

5.1.1 Location

Lake Roland is a reservoir located in Baltimore County, Maryland named for Roland Run, a nearby stream that feeds the lake. Also feeding Lake Roland are the Jones Falls, Towson Run, and several unnamed tributaries. Lake Roland empties into the Jones Falls watershed.

5.1.2 Geology/Soils

The Northeastern Jones Falls watershed lies entirely within the Piedmont region in Maryland which indicates the underlying rock is mainly crystalline schist and gneiss along with smaller portions of marble. The areas of schist and gneiss metamorphic rock will generally be less vulnerable to contamination due to a relatively low infiltration rate and lower groundwater recharge rates.

The landscape is characterized by steep slopes, which are prone to more soil erosion and a possibility for a greater amount of pollutants. The area with the most extreme slope is at Lake Roland where the surrounding subwatersheds drain directly toward. The topography specifically in Lake Roland, varies and is therefore very susceptible to erosion. Soil type and moisture conditions greatly affect how land may be used and the potential for vegetation and habitat on the land. One determining factor for water quality and quantity in streams and rivers is the condition of the soil. This is an important factor to consider for projects aimed at improving water quality or habitat. Table 5.1 shows the acreage and percentage of the Coastal Plain and Piedmont within the Jones Falls watershed in Baltimore County.

Table 5.1: Geology of Jones Falls Watershed

Coastal Plain Percent	Peidmont Percent	Coastal Plain Acres	Peidmont Acres
3%	97%	796.4	25,136.7

The Natural Resource Conservation Service classifies soils into four Hydrologic Soil Groups (HSGs) based on the soil's runoff potential. Runoff potential is the opposite of infiltration capacity; soils with high infiltration capacity will have low runoff potential, and vice versa. The four Hydrologic Soils Groups are A, B, C and D, where A's generally have the lowest runoff potential and D's have the greatest runoff potential. Dual hydrologic soil groups can be assigned as well. This happens when certain wet soils are placed in group D based solely on the presence of a water table within 24 inches of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. The soil group characterization is summarized below in table 5.2.(USDA-NRCS 2009)

Table 5.2: Acreage of Jones Falls in Baltimore County

Hydrologic Soil Group	Description	Acres	Percent within Watershed in Baltimore County
A	Soils which have a low runoff potential and high infiltration rates when thoroughly wet. The depth to a permanent water table is deeper than 6 feet.	970.9	3.7%
B	Soils which have moderate infiltration rates when thoroughly wet. Water movement is moderately rapid and depth to a permanent water table is deeper than 2 feet.	16322.7	62.9%
B/D	Dual hydrologic soil group: Group B has moderate infiltration rate when thoroughly wet; Group D assignment is based solely on the presence of a water table within 24 inches of the surface.	23.5	0.1%
C	Soils which have a slow rate of infiltration when thoroughly wet and moderately high runoff potential since water movement through these soils is moderate or moderately slow and they generally consist of a layer that impedes downward movement of water.	5138.7	19.8%
C/D	Dual hydrologic soil group: Group C has slow infiltration rate when thoroughly wet and moderately high runoff potential; Group D assignment is based solely on the presence of a water table within 24 inches of the surface.	-	0.0%
D	Soils which have the highest runoff potential and very low infiltration rates when thoroughly wet. Water movement through the soil is slow or very slow. Generally consists of a restrictive layer of nearly impervious material within 20 inches of the soil surface.	2806.3	10.8%

5.1.3 Stream Systems

Stream systems are a fundamental natural resource within the watershed. Maintaining a healthy stream system requires preserving stream flows and water quality which mimic the conditions found in a naturally occurring un-impacted watershed.

The Jones Falls watershed contains approximately 154.2 miles of streams, all of which ultimately drain towards the Chesapeake Bay.

5.2 The Human Modified Landscape

5.2.1 Land Use

The goal is for the watershed to absorb the nutrients before coming into direct contact with the stream. The way the land is cultivated has a direct impact on the habitat and the water quality. Impervious surfaces, such as; roads, parking lots, and roofs hinder this process. This accelerates the flow rates, concentrating the stormwater runoff and can cause erosion in the habitat and streams. In an agricultural landscape of crop and pasture there is potential for an increase in nutrients and bacteria. Table 5.3 shows the land use as of 2011 for the 23,915 acres of the Jones Falls watershed in Baltimore County (land use data was derived from the USGS National Land Cover Database 2011 (Jin, 2013) combined with Baltimore County 2011 impervious surface data.)

Table 5.3: Land use in Jones Falls

Land Use	Acres	Portion of Watershed
Water	76.9	0.32%
Pasture	945.8	3.95%
Crop	1130.7	4.73%
Forest	9552.9	39.95%
Urban Pervious	8589.3	35.92%
Urban Impervious	3614.3	15.11%
Extractive	4.7	0.02%
Total	23,914.6	100%

5.2.2 Population

With naturally increasing population there is an increased potential for environmental degradation. The urban/ suburban development increases the population density and therefore more impervious surfaces which have a direct link to water quality degradation. Lake Roland is in a low density zone however located directly above it is Towson Run, Roland Run, and Ruxton Run which are highly populated subwatersheds. These drain directly into the Lake Roland area. Population data for 2008 and 2010 and the percent change over time in the Jones Falls watershed is shown in table 5.4.

Table 5.4: Total Population in Baseline Year

PCB BaselineYear	BaselineYearPopulation	Census_2010	Acres in Watershed
2010	64,881	64,881	25,933

5.2.3 Infrastructure

5.2.3.1 Drinking Water

Drinking water is a fundamental need for human development. Drinking water can be supplied by either public distribution systems or by wells associated with individual developed properties. Having an adequate supply of drinking water is essential to maintaining the human population in a region. Most of the development within the Northeastern Jones Falls planning area is served by public water.

5.2.3.2 Septic Systems

Septic systems provide treatment for phosphorus, but leak nitrogen in the form of nitrates. These nitrates may either be reduced or eliminated through denitrification. During this process the water passes through riparian buffers. If a system fails the result is an increased contamination of the aquatic environment by way of increased nitrogen, phosphorus, and other chemicals. They can also result in increased bacterial contamination of the waterways and potential for human health concerns. Using the Bay Restoration Fund 2014 data, we can estimate the population using septic systems which is summarized below in table 5.5.

Table 5.5: Total Population on Septic in Jones Falls

Percent Septic	Baseline Population on Septic	Current Population on Septic
15.81%	10,261	10,261

5.2.3.3 Sanitary Sewer

There is one active pumping station located in the Lake Roland Direct Drainage subwatershed. In general a public sewer system conveys wastewater from individual residences or businesses to a facility that treats the wastewater prior to discharge. The sewer system consists of a piping system and cleanouts that are owned by the individual property owner, who is responsible for the maintenance of this part of the system. The portion of sewer system that is in the public right-of-way is owned and maintained by the local government. The public system consists of the gravity piping system, access manholes, pumping stations, and force mains. The sanitary sewer infrastructure within the Jones Falls watershed in Baltimore County is summarized below in table 5.6.

Table 5.6: Total Population on Public Sewer & Miles

Baseline Population on Public Sewer	54,620
Current Population on Public Sewer	54,620
Gravity Main Miles	228.5
Pressure Main Miles	9.5
Number of Pumping Stations	28

5.2.3.4 SWM Facilities

Starting in the mid-1980s stormwater management was required by Maryland Department of the Environment for new development to control the quantity of runoff. Those regulations provided an exemption for large lot subdivisions (>2 acres). Large lot subdivisions only had to provide stormwater management for roads. The regulations evolved from the initial requirement of water quantity control to including water quality control in the early 1990s; and in 2000 a new stormwater design manual was released by Maryland Department of the Environment requiring additional water quality and quantity controls along with stormwater management for large lot subdivisions.

There are a variety of types of stormwater management facilities that have different pollutant removal capabilities. The initial dry pond design for water quantity management has the lowest pollutant removal efficiency, while those facilities that infiltrate or filter the water have among the highest pollutant removal capabilities. Stormwater BMPs are not designed to remove PCBs, but they may capture and store PCBs, preventing or delaying the entry of PCBs into the waterway. The data is summarized below in table 5.7.

Table 5.7: Stormwater Facility County in the Jones Falls Watershed

BMP Type	Count	Acres Treated
Detention	75	1,481.6
Extended Detention	115	1,243.0
Wet Pond or Wetland	12	724.0
Filtering Practice	83	298.7
Infiltration practice	44	65.0
Environmental Site Design	15	11.1

5.2.4 Source Distribution

PCBs were used in building construction materials, and were produced in the United States from 1929 to until they were banned in 1979. Structures built or renovated during this PCB era might release PCBs into the environment due to weathering, repairs, renovations, or demolition. Construction dates, structure size, and parcel size information is available from the Maryland Department of Assessments and Taxation through Baltimore County's landuse geodatabase. Parcels were grouped by construction date into PCB era (1929 to 1979), Pre-PCB era (before 1929), and Post-PCB era (after 1979). As table 5.8 shows, the majority of structures in Jones Falls watershed were built during the PCB era. The map in figure 1.3 shows the patchy distribution of structures by era. Most areas are dominated by PCB era structures, but there are many areas dominated by Post-PCB era structures, and a few areas dominated by Pre-PCB era structures. The data is summarized below in table 5.8.

Table 5.8: Construction History in Jones Falls Watershed

Era	Number of Parcels Built	Structure Square Footage	Acreage of Parcels Built
Pre PCB Era (before1929)	1,363	4,294,994	2,407.8
PCB Era (1929-1979)	11,640	29,376,424	7,517.0
Post PCB Era (after 1979)	6,168	25,601,296	4,815.8

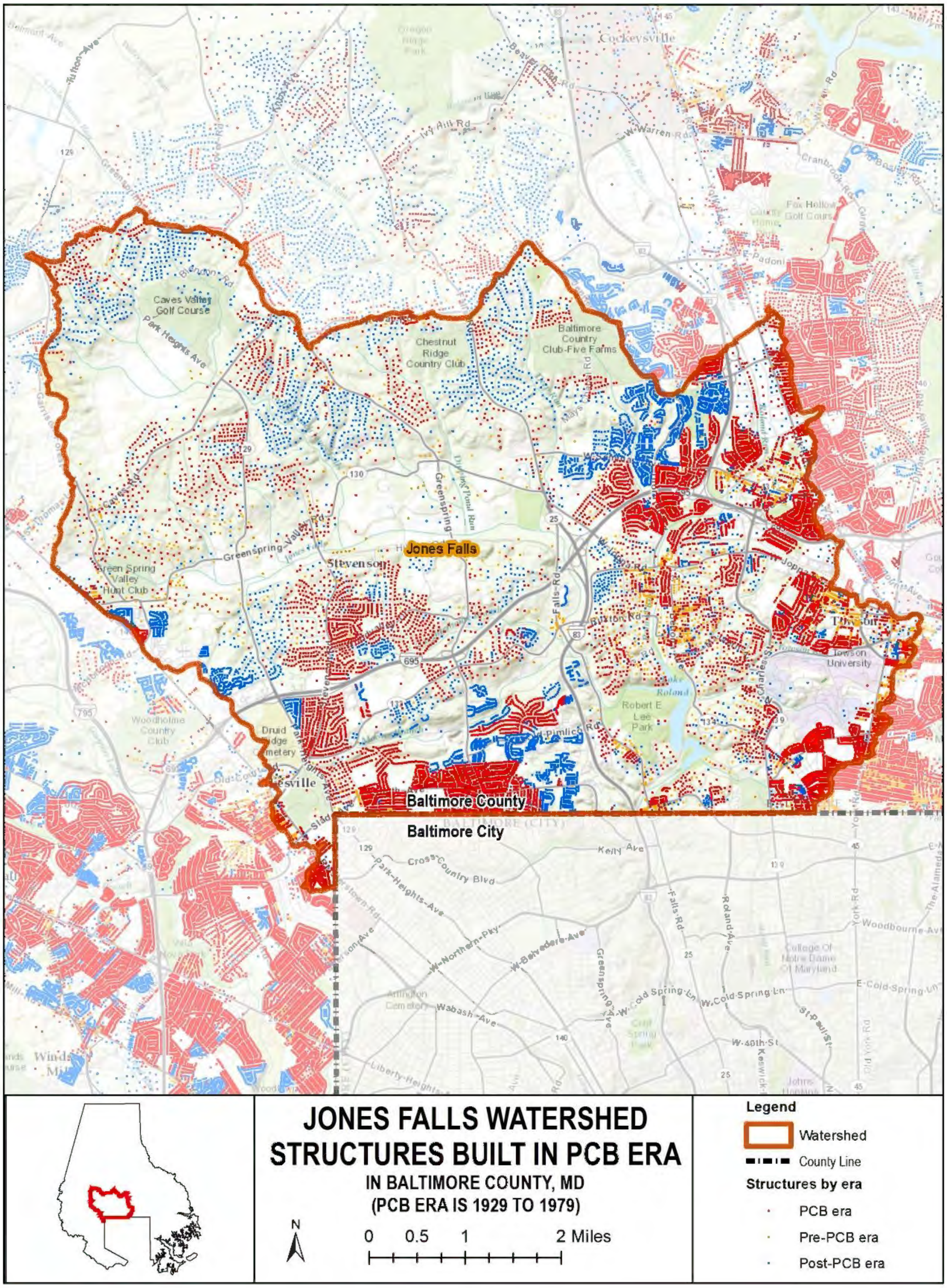

Figure 5.1: Map of Structures by PCB Era in Jones Falls Watershed in Baltimore County

The purpose of this section is to summarize what is currently known through monitoring data regarding PCBs within the Jones Falls watershed Implementation Plan. Lake Roland Impoundment and its watershed will be the focus since MDE issued it a PCB TMDL for Lake Roland. Baltimore County does not have any current PCB monitoring data; therefore MDE's studies will be examined. Those studies can be found on MDE's website.

6.1 Maryland Department of Environment:

"*Characterization of PCB Bioavailability*" (2005) and "*Total Maximum Daily Load of Polychlorinated Biphenyls in Lake Roland of Jones Falls Watershed*" (2013)

There were 2 studies conducted in the Jones Falls watershed by MDE. As stated in Section 4: Literature Summary, PCBs tend to bioaccumulate or become more persistent as they progresses up the food chain. A 2000 fish tissue survey resulted in Lake Roland, an impoundment on the Jones Falls, being labeled as impaired for PCBs and being issued a fish consumption advisory. This label meant that a TMDL would have to be developed for Lake Roland. In order to fully develop a TMDL, more fish tissue data would be required. Sediment and water column Total PCB (tPCB) monitoring data was also used in preparing the TMDL. During the time between the TMDL development data collection, a separate MDE study was conducted. This study used well established, non-native Asiatic clam (*Corbicula fluminea),* to determine the bioavailability of PCB. This study was a cost-effective way to characterize subwatersheds potentially draining significant amounts of PCBs and acted as a first screening tool to identify and remediate potential sources of PCBs (MDE 2005). No follow-up study was done to further identify the potential PCB sources in the Jones Falls watershed.

According to MDE, Lake Roland is categorized as a Use I – Water Contact Recreation and Protection of Non-tidal Warm water Aquatic Life, which applies to waters that are suitable for a) water contact sports b) play and leisure activities where individuals may come in direct contact with the surface water c) fishing d) the growth and propagation of fish, other aquatic life, and wildlife e) agricultural water supply and f) industrial water supply (MDE 2013). MDE issued a fish consumption advisory in 2000 and PCB impairment status for Lake Roland after fish tissue samples were analyzed for tPCB concentrations and exceeded the 39.0 ng/g threshold. This consumption advisory was meant to protect the public, particularly pregnant women and children, from consuming fish from Lake Roland that contained potentially dangerous levels of PCBs. This impairment label established the need for a PCB TMDL for Lake Roland to ensure that Lake Roland's "fishing use" designation was supported. Fish tissue (2000, 2007), sediment (2010), and water column (2010) tPCB data were used to create baseline loads. A water quality model was created using the baseline data to estimate required load reductions of PCBs in order to meet the TMDL water column and sediment endpoint concentrations. These endpoints were derived from the fish tissue threshold and site specific total Bioaccumulation Factors (tBAFs). This was used to estimate the amount of time necessary for tPCB concentrations to reach the TMDL water column and sediment endpoints, based on the required load reductions from the individual source sectors (MDE 2013). All these parameters were measured in order to support Lake Roland's "fishing use" designation. For further explanation regarding the formation of Lake Roland's PCB TMDL, refer to Section 3: TMDL Summary.

In 2005, MDE documented the *"Caged Clam study to Characterize PCB Bioavailability in the Impaired Watershed throughout the State of Maryland*." The rationale for using bivalve exposure studies is that the resulting data reflects those PCB congeners that are being accumulated (MDE 2005). Also, because the clams used in MDE's study filter feed over an extended period of time, reflect results that are representative of average longer-term conditions (MDE 2005). The sampling stations within the Jones Falls watershed are located in Figure 6-1. The *Corbicula* study created a reference threshold by collecting relatively uncontaminated populations of *Corbicula fluminea* from the Upper Choptank River at Red Bridges. This clam population was selected because it received minimal exposure to PCBs. The mean tPCB from those clams became the reference threshold (3.72 ng/g). The formula to develop the reference threshold used the mean tPCB concentration from the reference site, plus 3 reference site standard deviations (MDE 2005). This threshold would be compared to four Baltimore County sampling stations, with known PCB impairment, throughout the Jones Falls Watershed (Figure 6.1). Each site had two replications with difference exposure times (A= 2 week exposure, B=4 week exposure). See Reference Threshold formula below:

Reference Threshold = $\bar{x}_{ref} + (3 \times SD_{ref})$
RT = 2.7999 ng/g + (3 x 0.3083 ng/g) = 3.7239 ng/g ≈ 3.72 ng/g

RT= 3.72 ng/g

Where:
$\bar{x}_{ref}$ – reference site mean (average) concentration (ng/g)
SD_{ref} – reference site standard deviation

6.1.1 Summary of Data Results

In order to create a PCB TMDL for Lake Roland, MDE had to first determine the baseline loading of PCBs from atmospheric deposition, non-regulated watershed runoff, contaminated sites, and point sources (MDE 2013). The tPCB baseline loads can be seen in Table 3.2 in Section 3: TMDL Summary. Once the baseline was established, the result was a 29% required tPCB load reduction for all sources to achieve the sediment and water column TMDL endpoints.

MDE conducted fish tissue tPCB concentration surveys in 2000 and 2007 in Lake Roland. Both surveys resulted in fish tissue tPCB concentrations that were above the impaired threshold of 39.0 ng/g. Lake Roland's baseline levels in the water column and sediment tPCB concentrations were unknown, therefore a water and sediment concentration survey was conducted in 2010 (Table 6.1). The results can be seen in Table 6.2. Raw fish tissue, sediment, and water column data used to establish the PCB TMDL can be found in Appendix 6.

Table 6.1: Water Column and sediment tPCB concentration (Sampling year 2010)

tPCB Data	Units	Sample Size	tPCB		
			Average	Maximum	Minimum
Water Column	ng/L	24	1.98	5.41	0.16
Sediment	ng/g	4	84.3	109.5	72.0

Table 6.2: Fish tissue tPCB concentration

Sampling Year	Location	Sample Size	tPCB (ng/g)		
			Average	Maximum	Minimum
2000	Lake Roland	6	79.88	146.18	48.65
2003	Jones Falls upstream of Lake Roland	4	22.85	39.46	10.39
2007	Lake Roland	5	43.48	78.24	14.72

MDE's 2005 *Corbicula* study identified the Jones Falls watershed as one with elevated PCB levels. Therefore it would receive priority for action or future monitoring (MDE 2005). The only further action taken after this study was the establishment of a PCB TMDL for Lake Roland which lies within the Jones Falls Watershed. There were six total stations the Jones Falls Watershed, four of which were located in Baltimore County Boundaries (Figure 6.1). The other 2 were located in Baltimore City. The 4 Baltimore County stations' results are listed in Table 6.3. The Reference Threshold was calculated by establishing a threshold from the reference site in the Upper Choptank River. Once collected and analyzed the mean or average of the tPCB concentration from each station was compared to the Reference Threshold.

The furthest upstream station, JonF-05 had the lowest mean tPCB concentration (5.52 ng/g). JonFEx station was located on a Jones Falls tributary named Deep Run. This tributary's confluence is below JonF-05. JonFEx displayed the highest level of mean tPCB concentration, which was 49 times the reference threshold. JonF-02 is located on the Jones Falls main stem below the confluence with Deep Run. This station had a mean tPCB of 8.50 ng/g. This was three times the reference threshold. Jones Falls flows into Lake Roland, below station JonF-02; Lake Roland is a man-made impoundment that receives inputs from other watersheds outside of MDE's study. JonF-03 was located downstream of Lake Roland Dam. The mean tPCB concentration was 11.46 ng/g. This result was 4 times the reference threshold.

JonF-05's low mean tPCB may indicate that this portion of the Jones Falls is not a major contributor of tPCB. JonFEx's high mean tPCB indicates that Deep Run may be the primary delivery system of tPCB to Lake Roland. The study did not investigate and identify any sources that may have caused the elevated tPCB concentrations in JonFEx. Further study is needed to identify potential PCB sources and mitigate them. The increase of tPCB concentration from Station JonF-05 to JonF-02 could be a result of the tPCB delivery from Deep Run. The mean tPCB result from JonF-03 is expected due to man-made impoundments which tend to collect sediment above the dam, and PCBs then adhere to sediment particles resulting in contaminated surface sediments (MDE 2013). These surface sediments can be disturbed by increased flows during storm events thus increasing tPCB concentrations heading downstream. Another potential PCB source could come from the North Eastern subwatershed of Jones Falls. This subwatershed includes Towson run, Ruxton Run, and Roland Run. All of which, drain from more urbanized, industrial areas. MDE's 2005 *Corbicula* study did not have a sampling station within this subwatershed and further study may be required.

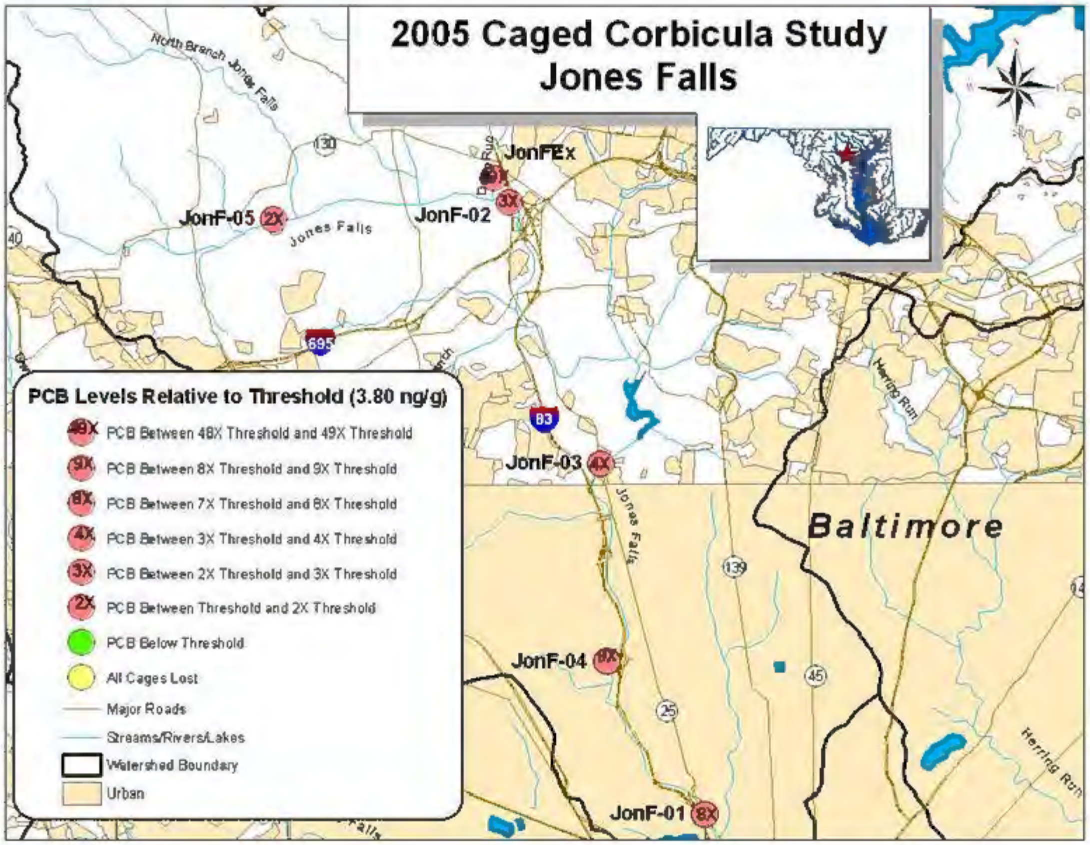

Figure 6.1. Map of Jones Falls PCB *Corbicula* Stations

Table 6.3: PCB Results for Baltimore County Jones Falls Stations

Station	Location	tPCBs (ng/g)		Mean tPCB (ng/g)	Increase over threshold
		S1	S2		
JonF-02_A/B	JF @ Falls Rd. Crossing	8.91	9.09	8.5	3X
JonF-03_A/B	JF @ Falls Rd. Crossing Downstream of Lake Roland	10.66	12.26	11.46	4X
JonF-05_A/B	Jones Falls at Stevenson Road Crossing	4.91	6.13	5.52	2X
JonFEx_A/B	Deep Run at Meadowwood Park	256.68	104.36	180.52	49X

6.1.2 Comparison of Data to TMDL Targets

As stated in Section 3: TMDL Summary, the Lake Roland tPCB load reduction is set as 29% reduction or 43.0 g/year of tPCB concentrations in sediments and the water column in order to reach desired end points. In theory, if these end points are met then the tPCB concentration in fish tissue will reflect the load reductions and concentrations will fall below the 39.0 ng/g.

6.2 Baltimore County Data

Currently, Baltimore Count does not have a PCB monitoring program; however this Implementation Plan intends to develop one.

Section 7 - Summary of Existing Restoration Plans

Baltimore County has already developed management plans that aim to remove certain pollutants in parts of the Jones Falls watershed. For the Lake Roland drainage area of the Jones Falls, there is the Northeastern Jones Falls Small Watershed Action Plan. Small Watershed Action Plans (SWAPs) include local based goals and objectives that are beyond the scope of the TMDL IP. All completed SWAP documents and their appendices are available online. This past study was used to inform the Implementation Plan. The following subsections provide more specific information for the SWAP.

7.1 Northeastern Jones Falls Small Watershed Action Plan, 2012

The *Northeastern Jones Falls Small Watershed Action Plan* (SWAP) addresses a 10.9 square mile portion of the Jones Falls watershed, making up the north eastern part of the Jones Falls watershed that is within Baltimore County. Northeastern Jones Falls includes the four sub-watersheds: Roland Run, Ruxton Run, Towson Run, and the Lake Roland Direct Drainage. The Northeastern Jones falls represents 19% of the entire Jones Falls watershed.

The SWAP is a strategy for restoring the Northeastern Jones Falls. It was developed, in 2012, by Baltimore County Department of Environmental Protection and Sustainability with extensive input from county citizens, county agencies, members of watershed associations, and various institutions. The action plan outlines recommendations for watershed restoration, describes management strategies for each of the four sub watersheds, and identifies priority projects for implementation. The plan also includes cost estimates for certain potential actions and a schedule for implementation over a 13 year timeline. Financial and technical partners are suggested for implementation of various potential actions.

7.1.1 SWAP Vision and Goals

Northeastern Jones Falls SWAP Vision:

The Northeastern Jones Falls Steering Committee adopted the following vision statement that served as a guide in the development of the SWAP:

We envision a healthy, vibrant Northeastern Jones Falls watershed, which protects high quality streams and is supportive of diverse aquatic life. Our watershed conserves treasured natural resources and maintains and celebrates our residential character and landscape for today and for future generations.

Northeastern Jones Falls SWAP Goals:

- Goal 1: Increase Citizen Participation with Restoration Projects
- Goal 2: Encourage Collaboration with the Institutional Landowners and Baltimore County EPS on Restoration Projects
- Goal 3: Enhance Natural Resources on Public Property

This section provides an overview of pollutant reduction measures and their predicted effectiveness. This overview is meant to serve as a guide to aid in selecting the most efficient possible BMPs that may be implemented to meet the pollutant reduction goals required by the TMDL. It is possible that only some of the listed actions in this section will be selected for inclusion in Section 9 of this Implementation Plan

In the past PCBs were found in many products and today may still be produced as a byproduct from various industrial processes. Through improper disposal these contaminated materials with PCBs can contaminate the soil and water. There are many ways to potentially remove PCBs from the environment. However the general efficiency is unknown and most mechanical BMPs (ie. Dredging, in-situ thermal) tend to be very expensive. Due to PCB's ability to cling to sediment particles, the BMPs that will be established will attempt to reduce the amount of sediment entering the Jones Falls upstream of Lake Roland. This will reduce the amount of PCB laden sediment from entering Lake Roland and accumulating on the bottom.

Building Demolition and Remodeling

The purpose of identifying the storage or use of PCBs is to eliminate materials containing PCBs. In order to do this building inspectors must be trained to identify PCB containing equipment and materials. Currently there is no way to identify buildings that contain PCB materials or equipment, other than site inspection. (SFEI. 2010)

Street Sweeping

The process of Removing PCBs associated with particles that are dispersed onto impervious surfaces, before the particles can enter the storm drain system. (SFEI. 2010)

Stormdrain and Stormwater Management Sediment Removal

The Removal of PCBs associated with particles that are deposited in stormdrains and stormwater management facilities. (SFEI. 2010)

Soil Remediation

The process of Identifying known PCB contamination sites by querying regulatory databases, measure concentration of PCBs in soil, then remove and replace the soil. (SFEI. 2010)

Source Control

This process includes identifying any storage or use of PCBs and eliminating the PCB containing materials. There is a need to train building and industrial inspectors to identify PCB containing equipment and materials to accomplish this. (SFEI. 2010)

Sediment Settling

The process of using treatment controls which are engineered devices or environments that can be installed or built in place to enhance the capture of an undesirable constituent such as sediment, PCBs, or Hg. (SFEI. 2010)

Capture and Reuse

In the case of PCBs, primary locations of reuse and/or treatment are mainly located near the tidal marsh areas of the Bay margin. (SFEI. 2010)

Biostimulation

The process of biostimulation involves the addition of a primer to galvanize targeted dechlorinating populations in PCB-contaminated soils. (NNEMS. August 2004)

Bioaugmentation

The process of bioaugmentation involves enriching a contaminated site with organisms capable of degrading the targeted compound. (NNEMS. August 2004)

Aerobic Biodegradation

The process involves degradation of the PCBs via the *bph (*biphenyl pathway) pathway.

(NNEMS. August 2004).

Reductive Dechlorination by Nanoscale Zero-Valent Iron

Current research is exploring the ability of using nanoscale zero-valent iron particles to reduce and de-chlorinate PCBs. (NNEMS. August 2004)

In-Situ Thermal Desorption

The process of using ISTD technology includes direct application of heat supplied by electrical heater elements to raise the temp of soil in-situ to destroy the organic contaminant with thermal blankets or thermal wells. (TTES RTES. 1998)

Table 8.1: Reduction efficiencies for bacteria

PCB BMPs	
Best Management Practice	**Efficiency**
Building Demolition & Remodeling	Unknown
Street Sweeping	Unknown
Stormdrain & Stormwater Mgmt. Sediment Removal	Unknown
Soil Remediation	To be calculated per project.
Source Control	Unknown
Sediment Settling	50% of PCBs settle out in 20 min or less
Capture & Reuse	Unknown
Biostimulation	Nearly complete C dechlorination
Bioaugmentation	Unknown
Aerobic Biodegradation	Unknown
Reductive Dechlorination by Nanoscale Zero-Valent Iron	Unknown
In-Situ Thermal Desorption	100%

Discussion of Uncertainty

Literature reviews have been mostly inconclusive based on the removal efficiency per BMP. In order to retrieve more sufficient information for removal rates further testing must be done. Only a select few of the BMPs listed showed sufficient data. For example the effectiveness of sediment settling, Biostimulation, and In-Situ Thermal Desorption were found to significantly improve the sediment samples post treatment.

In this section you will find a list of actions that together become one scenario as to how the county could reach the pollutant load target. While EPS has developed this scenario, progress will be assessed on an annual basis through results of implementation actions and monitoring data. It is intended that the IP will be reviewed on a five-year cycle for potential revisions. The county takes an adaptive management approach to all watershed planning efforts.

Adaptive management is a decision process that promotes flexible decision making that be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood (U.S Department of the Interior 2009). The tools that Baltimore County will use in adaptive management are the tracking of implementation progress through the various actions proposed in the strategy in this section, identification of barriers that prevent targeted actions from occurring, and an enhanced monitoring program to measure progress in both reductions and meeting water quality standards. While this will be an on-going process, there will be a formal review of the strategy at five year intervals to determine if changes are needed or if the strategies are on track.

This Implementation section will provide a description of programmatic, management, and restoration actions; and pollutant load reduction calculations to meet the pollutant reduction target for the specific pollutant. For each of the programmatic, management, and restoration actions there will be a list of responsible parties, actions, timeframe of actions, and performance standards.

For this section, we will bring together information from earlier sections of this Implementation Plan to determine actions that will reduce pollutant inputs to acceptable regulatory levels. We will consider the existing data on pollution input levels (Section 6), existing restoration plans (Section 7), and the efficiencies of known Best Management Practices (BMPs) for pollution reductions (Section 8). By examining our existing data on pollution loads we can know how much of a reduction is needed to reach water quality goals, and what needs to be done to reach those goals.

The manufacture and sale of PCBs has been banned in the United States since 1979, however the ban did not extend to the use of PCB containing products that may still be in operation today. PCBs are very stable chemicals, meaning they do not readily break down in the environment, and may remain toxic for extended periods of time. These two factors are likely large contributors of PCBs to the environment over time.

PCBs are not pollutants that are expected to be found over widespread areas (with the exception of PCBs that are deposited atmospherically), but are expected to be found in small areas of higher concentrations, which we will refer to as spot sources. An example of a spot source may be one of the multiple locations of blown power transformers, which may have at one time leaked PCBs into a small area. Locating higher concentrations of PCBs through the use of monitoring studies and field assessments will be a high priority in the effort to stop PCBs from entering the waterways from their spot sources.

The actions discussed in this section are to be implemented in addition to currently in-progress or completed programs and restoration actions, some of which may have been discussed in Section 7 of this Implementation Plan. Because the production of PCBs has been banned over 35 years ago, the focuses of this implementation plan will be on managing PCBs currently in use.

9.1 Actions

The actions below are divided into programmatic actions, management actions, and restoration actions. Programmatic actions are actions that do not directly result in load reductions, but create the necessary conditions for load reduction. Management actions are those where there is regular management of county property, such as, street sweeping. Restoration actions include measures such as the development of new control measures aimed to reduce pollutant loads as well as retrofits of existing stormwater management facilities.

Programmatic and Restoration Actions

Programmatic actions are actions that do not directly result in load reductions, but create the necessary conditions for load reduction. Actions within this category might include public education and outreach activities, monitoring, or supporting specific legislation. These actions will move Baltimore County closer to achieving TMDL targets; however, there is currently no way to attribute a predictable pollutant load reduction to programmatic actions. Some programmatic actions, such as investigation and monitoring, are necessary to implement management and restoration actions or make those actions more efficient. Other programmatic actions, such as education and outreach actions, are predicted to increase the load reduction over time through behavioral change and/or BMP implementation by individual citizens. The exact load reduction is not predictable because the participation rate for individual home owners installing BMPs, as a result of public education, is not yet known. Educated citizens may support load reductions in other ways such as educating other citizens about watershed management actions, supporting legislation that improves watershed management, and other actions that do not have associated load reductions but support the necessary condition for pollutant reduction.

Restoration actions include the development of new control measures aimed to reduce pollutant loads as well as retrofits of existing stormwater management facilities. It may include reforestation actions as well as any stormwater control measures that do not require regular management on county property. Restoration actions will have predictable load reductions, which will be used to calculate the contribution of each action toward meeting the overall load reduction required by the TMDL.

Management Actions

Management actions are those where there is regular management of county property, such as, street sweeping. It does not include the development of new control measures, such as, retrofitting highway yards. Management actions usually have predictable load reductions, which can be used to calculate the contribution of each action toward meeting the overall load reduction required by the TMDL.

Baltimore County’s street sweeping program will likely aid in reductions to atmospherically deposited PCBs on the streets. A good portion of the PCBs that are in the water already have become somewhat encapsulated by less contaminated sediment settling on top of it. Because of this, Baltimore County will continue to support stormwater management measures to reduce the probability of sediment-bound PCBs from re-entering the water column as a result of high storm flow.

Table 9.1 outlines the programmatic and restoration actions, as well as monitoring and reporting actions, that could potentially create on scenario to meet the TMDL.

Table 9.1: Programmatic and Restoration Actions with Performance Standards and Schedule

Action	Time Frame	Performance Standard	Responsible Parties
Programmatic Actions			
SWAP Implementation Committees to meet on a semi-annual basis to discuss implementation progress and assess any changes needed to meet goals	20 years	40 meetings (2 per year)	EPS and Implementation Committee partners
Hold Household Hazardous Waste Collection Events	On-going	# of events held	EPS, DPW
Work with MDE to develop a load reduction calculation that will link PCBs with sediment loadings	On-going	Calculation developed	EPS, MDE
Monitoring Actions			
Work with MDE to develop a local, or enhancement of the State's, fish tissue monitoring program to determine current levels of PCBs in fish tissue.	2 years	Fish tissue analysis program in place	EPS, MDE
Work with MDE to develop an enhanced bioaccumulation monitoring program for determining subwatersheds that have potential sources of PCBs. This program will focus on providing more specific locations of PCB measurements in areas identified as having high contaminant levels as reported in the 2005 Caged Corbicula Study.	2 years	Bioaccumulation monitoring program	EPS, MDE
Conduct survey of Jones Falls near Deep Run as needed (Accumulation Study indicated 49X background concentration of PCBs).	2 years	Results reported	EPS
Conduct field surveys, in subwatersheds found to have higher contaminant concentrations, prioritized by contamination level detected based on Bioaccumulation monitoring program.	18-20 years	Contamination sources of PCBs located.	EPS

Action	Time Frame	Performance Standard	Responsible Parties
Reporting Actions			
Continue to update status of restoration projects and BMPs in the Annual MS4 Report.	Annually	MS4 Report submitted to MDE and posted on county website	EPS
Implement the Continuing Public Outreach Plan.	On-going	Number of actions per year	EPS
Hold Biennial State of Our Watersheds Conference in even years.	Biennially	Conference Held	EPS
Adaptive Management assessment of the Implementation Plan.	5 year interval	Assessment complete	EPS
Restoration Actions			
Develop and implement remediation plans for any sites identified through the subwatershed surveys as contributing PCBs pollutants.	18-20 years	Remediation plans developed and implementation initiated	EPS, MDE

9.1.1 Sediment Reducing Actions

The actions described in this section are the same management and restoration actions that can be found in the Jones Falls TMDL Implementation Plan for sediment. PCBs adsorb to sediment, therefore we expect that sediment reducing BMPs will also reduce PCB loads. However, limited knowledge of the interactions between PCBs, sediments in stormwater, and these BMPs prevent reliable estimation of PCB reductions. Scientific evidence indicates that sediment reducing BMPs will also result in PCB reductions, however, efficiencies relating sediment reduction to PCB reduction are not yet know. This uncertainty is due in part to the nature of the relationship between sediment and PCB concentration. Initial literature searches have indicated that the relationship, if it exists, is quite variable and may not be a good predictor of PCB load reductions. The United State Geological Survey (USGS) on PCBs in stream sediment found that the frequency of detection of PCBs above the lower detection limit of 50 microgram/kg was only 18.8% (Wong, et.al., 2000). Baltimore County will work with MDE to develop a load reduction calculation for PCBs that will link sediment reductions to PCB reductions. The table below describes all of the sediment reducing actions that will take place in the Jones Falls watershed. Only those actions that are implemented in the drainage area of Lake Roland or affect waters upstream of Lake Roland have the potential to cause PCB reductions in the Lake Roland Impoundment. Also note that lag times for reducing PCBs by means of the actions listed below are unknown. Although we assume that reductions will result from these actions, it is not known how long it will take for the actions to have any measurable effect on the PCB levels in Lake Roland nor is it known what those reductions may be.

Table 9.2: Sediment Reducing Actions

Action	Time Frame	Performance Standard	Responsible Party
Street Sweeping Existing	Ongoing	Pounds removed	Baltimore County
Street Sweeping Proposed	Proposed Increase	Pounds Removed	Baltimore County
Storm Drain Cleaning	Ongoing	Pounds removed	Baltimore County
Stream Restoration	10 years	Stream restoration projects completed	Baltimore County
Stormwater Pond Conversions	10 years	Drainage acres converted	Baltimore County
Stormwater Retrofits	8 years	Retrofits completed	Baltimore County
Stream Buffer Reforestation	10 years	Acres reforested	Baltimore County, Blue Water Baltimore
Upland Reforestation	10 years	Acres planted	Blue Water Baltimore, SWAP Implementation Committee
Urban Tree Canopy	10 years	Acres planted	Blue Water Baltimore, SWAP Implementation Committee
Redevelopment	10 years	Acres Redeveloped	Baltimore County
Downspout Disconnection	10 years	Acres Disconnected	Baltimore County, Blue Water Baltimore, SWAP Implementation Committee

The assessment of implementation progress is based on two aspects; progress in meeting programmatic, management, and restoration actions; and progress in meeting water quality standards and any interim water quality benchmarks. The assessment of progress in meeting the restoration actions; includes setting up methods of data tracking, validation of projects, and pollutant load reductions associated with the actions (10.1) and will be consistent across all TMDL Implementation Plans. The assessment of progress in meeting water quality standards and interim milestones (10.2) is the data analysis associated with the monitoring plan specific to each TMDL Implementation Plan.

10.1 Implementation Progress: Data Tracking, Validation, Load Reduction Calculation, and Reporting

The Baltimore County Department of Environmental Protection and Sustainability – Watershed Management and Monitoring Section is currently preparing a document entitled *Baltimore County Method for Pollutant Load Calculations, Pollutant Load Reduction Calculations, and Impervious Area Treated*. This document will detail the data sources, data analysis (including pollutant load calculations, and pollutant load reductions calculations), validation of the practices, and reporting of progress made. It was determined that a document was needed to document how Baltimore County calculated pollutant loads and pollutant load reductions from the implementation of various best management practices, as guidance from the State continues to evolve. The document also needs modification based on the published literature and to include any additional findings that result from our monitoring programs. The document will be updated annually to account for any changes that may have occurred during the previous year. Due to the fact that implementation is being achieved through the actions of many county agencies, it was also determined that the means of data acquisition, any data manipulation, and the means of data analysis needs to be documented on an annual basis to provide consistency in the data acquisition and analysis and to document any changes in the process over time. The overall result is intended to provide transparency for the general public and users of reports on progress generated as a result of the analysis.

The Maryland Department of the Environment (MDE) has provided a guidance document for NPDES – MS4 permits entitled: *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated*. The draft document was released in June 2011, followed by a final release in August 2014. The document is intended to provide consistency among the MS4 jurisdictions in calculating baselines and reporting implementation progress. This document however, does not provide guidance on bacteria, chlordane, mercury, or PCB reduction efficiencies. MDE also provides guidance through its web site, with a webpage entitled *Maryland TMDL Data Center*. This site provides guidance on the development of the TMDL Implementation Plans and is updated on a regular basis.

The document *Baltimore County Method for Pollutant Load Calculations, Pollutant Load Reduction Calculations, and Impervious Area Treated* will be posted for review and comment in the spring of 2015. It will be modified on an annual basis to take into account any modifications to any guidance documents, monitoring results, and/or new literature; and future calculations will reference the edition on which the calculations were based.

10.1.1 Reporting

Baltimore County will prepare two-year milestones for each local TMDL in conformance with the Chesapeake Bay TMDL two-year milestone process. Programmatic actions and monitoring data analysis will be based on the calendar year, while restoration actions will be based on the fiscal year (July 1 – June 30). The current two-year milestone period was developed in January 2014; for Programmatic actions covers January 2014 through December 2015, and for restoration actions cover July 1, 2013 through June 30, 2015. When the next two-year milestones are developed in 2016, they will be presented by watershed and will include each of the local TMDLs.

Reporting will be done through the annual NPDES – MS4 Permit Report. This is technically due on the anniversary date of the permit renewal, but will be completed for submittal to MDE in October each year. The report will detail progress made in meeting each of the local TMDLs and the Chesapeake Bay TMDL. The analysis will include progress in meeting the two-year milestone programmatic and restoration actions, along with the calculated load reduction. It will also present the results of the monitoring conducted the previous year. See below for TDML specific monitoring.

In January of each year, a progress report (mostly extracted from the MS4 report) will be prepared and posted on the web.

10.2 Implementation Progress: Water Quality Monitoring

The rationale for the development of the Lake Roland PCB TMDL was the detection of PCB in certain fish tissues at levels that required the issuance of a consumption advisory that has been in place since 1986. Since fish tissue samples serve as the key source of data for PCB, Baltimore County will develop new monitoring programs to track PCB levels in fish tissue and to track bioavailability of PCB in the tributaries.

10.2.1 Fish Tissue Monitoring

The State has been monitoring fish tissue since the 1970s and PCB was initially suggested as an impairment from the result of monitoring the Lake Roland Impoundment in 2002. Two or more fish species, representing bottom feeders and higher trophic level predators, were targeted for collection at each monitoring location. Baltimore County will develop a program to monitor fish tissue in the tidal portion of Lake Roland on a three year cycle in conjunction with any State fish tissue monitoring. Baltimore County will work closely with the State to ensure a complete survey of fish tissue across the trophic levels is obtained for each cycle.

10.2.2 Bioavailability Monitoring

Caged bivalves (i.e. Asiatic Clam, *Corbicula fluminea*) have been successfully used as study organisms to screen for bioavailable toxin sources. Bivalves are frequently used in biological monitoring studies because of their widespread distribution and abundance in study areas, sedentary habits, hardiness, and ability to bioaccumulate pollutants without excessive mortality. They also give meaningful results which are representative of average long-term conditions since the clams filter-feed over an extended period of time. Using caged bivalves as a source tracking mechanism for bioavailability of PCB in subwatersheds draining to the Lake Roland impaired impoundment waters, the County can determine those subwatersheds with no apparent sources and those with relatively significant sources of PCB. The results of this study can be used to focus future search efforts towards identifying ongoing sources of PCB contamination.

Section 11 – Continuing Public Outreach Plan

In order to engage the public in the TMDL implementation process this continuing public outreach plan will be implemented upon approval of this TMDL Implementation Plan. The continuing public outreach plan is applicable to all TMDL Implementation Plans that are currently being developed and those developed in the future, as well as the Trash and Litter Reduction Strategy. This continuing public outreach plan is meant to engage county agencies, environmental groups, the business community, and the general public.

11.1 County Agencies

County agencies will be engaged through two regularly scheduled NPDES Management Committee meetings per year and other agencies meetings as necessary to move implementation forward.

11.1.1 NPDES Management Committee

The NPDES Management Committee is composed of representative agencies that are involved in meeting the NPDES – MS4 Permit requirements. This committee has met irregularly in the past, generally to review information on permit requirements and other upcoming regulatory requirements, such as, the General Industrial Stormwater Discharge Permit. In the future this committee will meet twice per year and will discuss not only the NPDES – MS4 Permit requirements, but also the TMDL Implementation Plans and progress being made in meeting the implementation strategy. In order to address all components of the TMDL Implementation Plans the committee membership will be expanded to include any county agency that has some responsibility for TMDL implementation. Examples being, the County Police Department and the Department of Environmental Protection and Sustainability – Groundwater Management Section. Prior to the development of the TMDL Implementation Plans and the Trash and Litter Reduction Strategy, these agencies were not specifically engaged in NPDES – MS4 Permit activities.

The first yearly meeting will be held in January of each year. The focus of this meeting will be to review the implementation plan 2-year milestones for each plan; provide a forum for discussion of the ability to meet the implementation actions; and determine any revisions necessary to meet the interim implementation milestones set in the plan. This meeting is also the forum for discussion of data tracking and reporting to ensure that the implementation actions are properly credited.

The second yearly meeting will be held in July of each year and will provide the forum for determining data submittal for the yearly progress report on the implementation actions and the resulting load reductions. The monitoring data from the previous calendar year will be presented and contrasted with the interim water quality milestones that are detailed in each implementation plan.

11.1.2 Other Agency Meetings

In order to move forward with implementation, agency meetings regarding specific implementation actions are anticipated. These will be scheduled as needed, and tracked by meeting date, attendance, TMDL Implementation Plans discussed, and topic. Meeting minutes will be reported in the Annual NPDES – MS4 Report submitted to Maryland Department of the Environment. This report is also posted on the County website for public access.

11.2 Environmental Groups

Baltimore County is currently engaged with local watershed associations through its funding of *Watershed Association Restoration Planning and Implementation Grants*, and through inclusion of watershed association members on the Steering Committees of the Small Watershed Action Plans. Formerly, this engagement and support was coordinated through the *Baltimore Watershed Agreement*. As part of that engagement, periodic Watershed Advisory Group (WAG) meetings were held. As part of this continuing public outreach plan, WAG participation will be formalized with two meetings per year.

The first meeting will be held in March of each year and focus on the local and Chesapeake Bay TMDL implementation actions and implementation progress, including an analysis of the pollutant load reduction calculations from the previous fiscal year. The watershed associations are currently engaged in citizen-based restoration activities and report their implementation progress to the county for inclusion in the Annual NPDES – MS4 Report. This meeting will provide a forum for discussion of the progress being made, coordination between the watershed associations, and any changes to the *Watershed Association Restoration Planning and Implementation Grant* being considered for the next grant period.

The second meeting will be held in November of each year and will focus on the water quality monitoring results from the previous calendar year. The results presented will compare trends and measures against the TMDL Implementation Plans water quality benchmarks and water quality standards.

11.3 Business Community

The business community will be engaged through various business forums, targeted outreach and education efforts on specific topics, and hosting workshops on specific topics as necessary.

11.3.1 Business Forums

Business forums, such as the Hunt Valley Business Forum with greater than 200 business members, provide opportunities to present the TMDL Implementation Plans and the Trash and Litter Reduction Strategy, and discuss the role of business in helping improve water quality. These forums will be convened as the opportunities arise. Summaries of these meetings will be reported in the annual NPDES – MS4 Report and will include the name of the forum (or other business organization), approximate number in attendance, the topic presented, and audience responses.

11.3.2 Targeted Business Outreach and Education

The Small Watershed Action Plan (SWAP) process includes an upland assessment of potential pollution hotspots. Often, these potential hotspots are commercial or industrial sites. The information derived from this assessment will be used to target outreach and education to businesses specific to the issue(s) at the location identified in each SWAP. These actions will be tracked and reported in the annual NPDES – MS4 Report.

11.3.3 Business Workshops

There are certain issues that may be pervasive through a segment of the business community that can most effectively be addressed through hosting workshop education on the specific topic. These issues will be identified as SWAP implementation moves forward, but one potential topic for a business workshop is related to the recently renewed *General Discharge Permit for*

Stormwater Associated with Industrial Activities. A workshop designed in conjunction with Maryland Department of the Environment would not only result in improved water quality, but it would also benefit the business community through increased understanding of the requirements of the permit.

11.4 General Public

The general public will be engaged through a number of mechanisms, including:

- WIP Team meetings
- Targeted outreach and education efforts on specific topics
- Steering Committee meetings and stakeholder meetings in the development of Small Watershed Action Plans
- Meetings of the Implementation Committee for completed Small Watershed Action Plans
- Displays at various events
- Annual progress reports posted on the county website and placed in our libraries
- A biennial *State of Our Watersheds* conference.

11.4.1 Watershed Implementation Plan (WIP) Team Meetings

Baltimore County has assembled a Watershed Implementation Plan (WIP) team to serve as a sounding board for the development of the WIP to address the Chesapeake Bay TMDL. Members of the team include representatives from various county agencies, business community representatives (particularly the environmental engineering community), watershed associations, representatives from the agricultural community, and Baltimore County citizens.

The county will schedule at least one meeting annually to present implementation progress and to address specific topics related to the TMDL Implementation Plans and the Trash and Litter Reduction Strategy. Meetings will be scheduled as issues arise. It is anticipated that the WIP team will provide initial review of newly developed outreach and education materials, in order to provide feedback from a variety of perspectives.

11.4.2 Targeted Outreach and Education

The Small Watershed Action Plan development process includes upland assessments of neighborhoods to identify pollution sources and restoration opportunities. This information will be used to prioritize and target outreach and education efforts specific to the issue(s) in neighborhoods with the intent to affect behavioral change and/or increase citizen based restoration actions. These actions will be tracked and reported in the annual NPDES – MS4 Report.

11.4.3 Small Watershed Action Plans (SWAPs)

Baltimore County has been developing Small Watershed Action Plans since 2008. There are 22 planning areas in the county, with 13 completed plans, 5 plans in development, and 4 areas pending. These planning areas cover the entire county. The planning process includes the development of a steering committee, the composition of which is determined by the issues, and land ownership within the planning area. At a minimum membership consists of agency representatives, watershed associations, and citizen representatives. The process also includes a number of stakeholder meetings, open to all planning area residents and businesses, which provide information on the plan and solicit input. Once the SWAP is complete, the steering committee becomes the implementation committee. As designed the implementation committee is to meet twice per year, however, most implementation committees have not met this goal.

The plans have addressed to varying degrees the TMDLs that are applicable within the planning area. Some of the TMDLs have been developed subsequent to the specific SWAP development or did not address the full range of TMDLs that were applicable to the planning area. The TMDL Implementation Plans are built on incorporation of the actions from each SWAP within the applicable TMDL area. In some cases, additional actions have been identified in order to meet water quality standards.

11.4.3.1 Small Watershed Action Plans in Development and Future Plans

For SWAPs currently under development, and for plans developed in the future, the steering committee and stakeholder meetings will be used for outreach regarding the TMDL Implementation Plans and the progress being made in achieving water quality standards. The meeting participants will be informed on where they can access the TMDL Implementation Plans, the Trash and Litter Reduction Strategy and any Progress Reports that have been developed.

Applicable TMDL Implementation Plan actions will be incorporated into the SWAP based on the assessment of applicable restoration actions within the SWAP planning area. Since the SWAPs incorporate field assessments of streams and uplands, they provide more detailed information on applicable restoration actions, both on quantity and location. The accelerated schedule for developing TMDL Implementation Plans precluded conducting field work to build the plans.

11.4.3.2 Small Watershed Action Plans Already Developed

For those SWAPs already developed, the implementation committee meetings will be scheduled twice per year. The first meeting will be held in winter and will present the implementation progress not only of the SWAP, but also any applicable TMDL Implementation Plan progress. The progress analysis will be based on fiscal year. This meeting will also provide the opportunity to discuss any changes in the SWAP or the TMDL Implementation Plan based on an analysis of what actions have been successful and what actions have been more difficult to implement.

The second implementation committee meeting will be held in fall of each year and will present the monitoring data in relation to progress being made in relation to interim milestones and water quality standards.

11.4.4 Educational Displays at Events

Educational displays and handouts will continue to be used at applicable events as they occur. The particular display and handout materials will be determined by the location and focus of the event. The location and focus of the event, number of citizens engaging staff at the display, and the number of handouts taken by citizens will be tracked for annual reporting in the NPDES – MS4 Report.

11.4.5 TMDL Implementation Plan, Trash and Litter Reduction Strategy, and Progress Report Availability

The TMDL Implementation Plans and the Trash and Litter Reduction Strategy will be posted on the Baltimore County website with hard copies placed in county libraries. The hard copies in the libraries will be specific to the watershed in which the library is located. Progress reports will be posted on the County website and placed in libraries. A set of hard copy plans will be kept at the Baltimore County Department of Environmental Protection and Sustainability

11.4.6 Biennial State of Our Watersheds Conference

Baltimore County, in conjunction with Baltimore City, has held *State of Our Watershed* conferences in the past to present information to county and city citizens on water quality issues applicable to the watersheds in these jurisdictions. Future conferences will be held in early March of even numbered years. Information on implementation progress for local TMDLs and the Bay TMDL will be presented, along with other topics of interest. These conferences will be organized with the assistance of the Watershed Advisory Group (WAG), and the surrounding local jurisdictions (Baltimore City, Howard County, Carroll County, Harford County, and York County, PA) will be invited to participate in the organization and presentation of the conference.

The timing of even years is related to the 2-year milestone process set up by the Maryland Chesapeake Bay TMDL Watershed Implementation Plan (WIP) whereby in January of even calendar years, progress in meeting the previous 2-year milestone programmatic and restoration implementation is reported and the next 2-year programmatic and restoration implementation milestones are proposed by the local jurisdictions. The timing of the conference not only permits reporting on the progress made in meeting the previous 2-year milestones but also what is planned for the next two years.

11.5 Summary of Continuing Public Outreach Plan

A summary of the continuing public outreach plan, by component, element and frequency is presented in Table 11.1.

Table 11.1: Continuing Public Outreach Plan Summary

Plan Component	Plan Element	Frequency
Agencies	NPDES Management Committee	2x per year
	Other Agency meetings	As needed
Environmental Groups	Watershed Advisory Group (WAG) meetings	2x per year
Business Community	Business Forums	As identified
	Targeted Business Outreach and Education	As identified
	Topical Workshop	As identified
General Public	WIP Team meetings	1x per year
	Targeted Outreach and Education	As identified
	SWAP – Steering Committee meetings	6x per year, each
	SWAP – Stakeholder meetings	2x per year, each
	SWAP – Implementation Committee meetings	2x per year, each
	Educational Displays at Events	As identified
	Document availability (various)	As needed
	Biennial Conference	Even # Years

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